A Review of Trenchless Watercourse Crossings in Alberta with Respect to Species at Risk

S. Nugent

Prairies Area
Fisheries and Oceans Canada
7646-8 Street N.E.
Calgary, AB
T2E 8X4

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by

S. Nugent

Prairies Area
Fisheries and Oceans Canada
7646-8 Street N.E.
Calgary, AB
T2E 8X4

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ABSTRACT

Nugent, S. 2011. A review of trenchless watercourse crossings in Alberta with respect to species at risk. Can. Manuscr. Rep. Fish. Aquat. Sci. 2947: vi + 69 p.

Operational Statements (OS) were developed by Fisheries and Oceans Canada to streamline the approval process for selected activities thought to pose little to no risk to fish and fish habitat, as defined under the *Fisheries Act*. In order to determine if the use of the OS for trenchless watercourse crossings provides adequate protection for aquatic species at risk (SAR), a review of trenchless watercourse crossing projects was undertaken. A total of 30 sites, crossed with either a directional drill or horizontal punch and bore, were evaluated and monitored within the province of Alberta. The streams were home to aquatic species listed on Schedule 1 of the *Species at Risk Act* (SARA) or currently designated by the Committee on the Status for Endangered Wildlife in Canada (COSEWIC). Results indicated compliance issues with the conditions and measures to protect fish and fish habitat outlined in the OS, including inadequate emergency preparedness and evidence of frac-out and open cut crossing methods. This review revealed sufficient problems with the application of the OS for trenchless watercourse crossings in aquatic species at risk habitat to indicate use of this streamlining tool, although likely appropriate for secure species, could be considered a potential threat to some SARA listed and COSEWIC designated species.

RÉSUMÉ

Nugent, S. 2011. A review of trenchless watercourse crossings in Alberta with respect to species at risk. Can. Manuscr. Rep. Fish. Aquat. Sci. 2947: vi + 69 p.

Les énoncés opérationnels (ÉO) ont été élaborés par Pêches et Océans Canada afin de simplifier le processus d'approbation pour certaines activités réputées poser peu de risque, sinon aucun, aux poissons et à leur habitat, au sens de la *Loi sur les pêches*. Dans le but de déterminer si l'utilisation de l'ÉO pour les franchissements de cours d'eau sans tranchée offre une protection adéquate aux espèces aquatiques en péril, on a entrepris un examen des projets de franchissements de cours d'eau sans tranchée. Un total de 30 sites, traversés au moyen d'un forage dirigé ou par perforation et perçage horizontal, ont été évalués et suivis au sein de la province d'Alberta. Les cours d'eau abritaient les espèces aquatiques inscrites à l'annexe 1 de la *Loi sur les espèces en péril* (LEP) ou actuellement désignées par le Comité sur la situation des espèces en péril au Canada (COSEPAC). Les résultats ont indiqué des problèmes de conformité aux conditions et aux mesures de protection des poissons et de leur habitat décrites dans l'ÉO, y compris une préparation insuffisante aux situations d'urgence et des signes de fracturation (« frac-out ») ou de méthodes de franchissement par tranchée ouverte. Cet examen a révélé suffisamment de problèmes avec l'application de l'ÉO pour les franchissements de cours d'eau sans tranchée dans l'habitat d'espèces aquatiques en péril pour indiquer que l'utilisation de cet outil de simplification, bien qu'elle soit appropriée pour les espèces protégées, pourrait être considérée comme une menace potentielle pour certaines espèces inscrites à l'annexe 1 de la LEP et désignées par le COSEPAC.

INTRODUCTION

In order to streamline the approvals process for works and undertakings around fish bearing watercourses, the Department of Fisheries and Oceans (DFO) introduced standard guidance for conducting selected activities that are considered low risk to fish and fish habitat. These documents, termed Operational Statements (OS), were developed for project proponent use in 2005 and aimed to provide nationally consistent advice on standard mitigation measures intended to protect fish and fish habitat (DFO 2006). Where possible, the OS have been customized on provincial/territorial levels to account for local environmental conditions and specific regulatory requirements. Where an OS can be used, no additional assessment by DFO Habitat Management staff is necessary (DFO 2006).

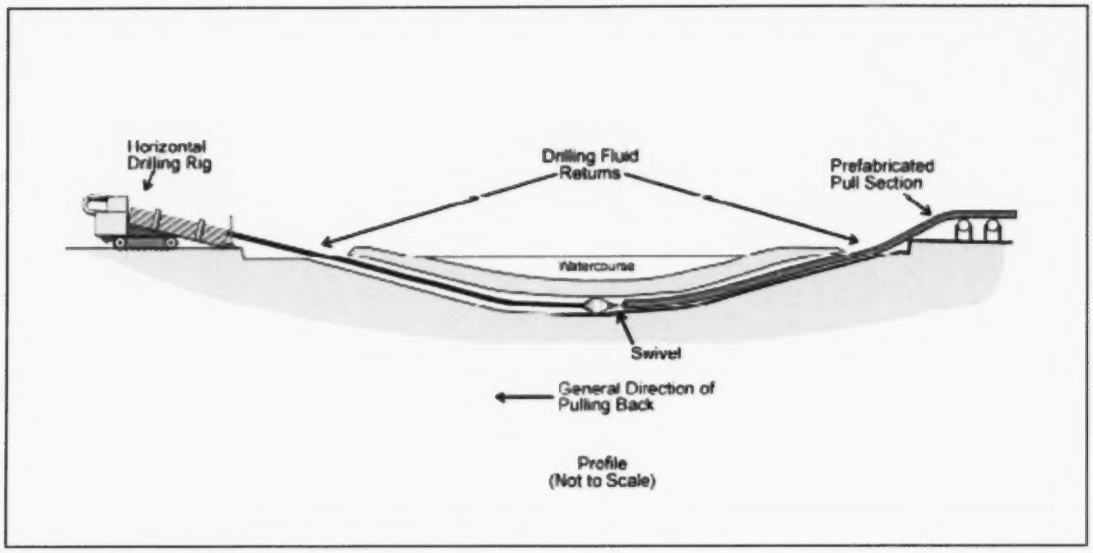
The proponent is required to review the Operational Statements available for their area of interest. If the conditions listed in the applicable OS can be met, the proponent may continue with their project without a formal review under the Habitat Provisions of the *Fisheries Act*. They are then asked, prior to undertaking the project(s), to submit a completed Notification Form (Appendix 1) to the Department. The notifications are logged into the DFO Habitat data management system (Program Activity Tracking for Habitat (PATH)) for monitoring purposes. There are currently 16 OS in circulation for the province of Alberta (http://www.dfo-mpo.gc.ca/regions/central/habitat/os-eo/provinces-territories-territoires/ab/index-eng.htm). Two of these relate to trenchless watercourse crossings, which are the focus of this assessment:

- High-Pressure Directional Drilling (HDD) (Appendix 2)(DFO 2007a)
- Horizontal Punch & Bore Crossings (HP&B) (Appendix 3)(DFO 2007b)

In Alberta, trenchless crossing methods are utilized by various industries for pipeline and telecommunication line installations. The Alberta Environment *Code of Practice for Pipelines and Telecommunication Lines Crossing a Water Body* (Alberta Environment 2007) considers a "trenchless method" to be a pipeline or telecommunication line stream crossing procedure in which there is no trenching of the bank and bed of a watercourse. The two types of trenchless crossings, high-pressure directional drilling and horizontal punch and bore, are briefly described below.

High-Pressure Directional Drilling (DFO 2007a)

In this method of trenchless crossing, a bore hole is drilled under a watercourse toward a surface point on the other side of the watercourse using pressurized mud systems. The pipe is then pulled back through the hole under the watercourse, with little or no anticipated negative effects on the bed and shore of the watercourse. A potential risk with this technique is related to the pressure of the drilling operation which can push the mud/fluids up to the surface causing a rupture known as a frac-out. A schematic of the high-pressure directional drilling technique is provided in Figure 1.



Source: CAPP et al. 2005

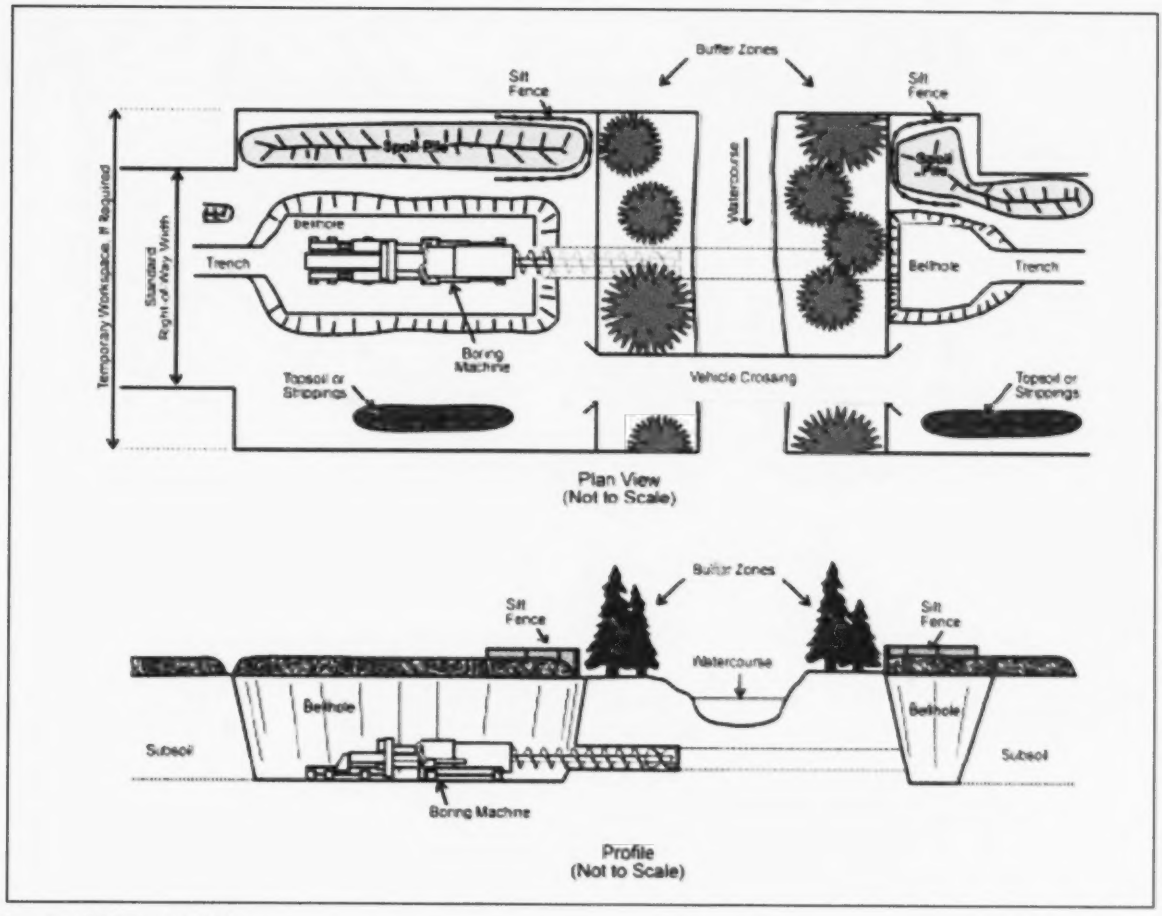
Figure 1: Schematic of Typical High-Pressure Directional Drilling Technique

Punch & Bore Crossing (DFO 2007b)

This technique involves digging a bell hole or shallow depression on either side of a watercourse (Figure 2). A horizontal punch/bore is then made between the two points under the watercourse, with little or no anticipated negative effects on the bed and shore of the watercourse. Of the two types of trenchless crossings, this is the preferred method from a fish habitat perspective. There are no pressurized fluids or mud involved in the process which removes the potential risk of frac-out during the pipeline installation. However, there is still some risk to fish and fish habitat if the bell hole or depression collapses during the pipeline installation.

As mentioned, the trenchless crossing methods are considered to have effects that are well understood and easily mitigated when occurring in areas with general fish habitat (DFO 2006). However, the effects of such activities on areas with sensitive species are not as readily understood and have not been well documented.

In 2003, the *Species at Risk Act* (SARA) came into force, and its prohibitions became enforceable in 2004. The purpose of SARA is to prevent wildlife from becoming extirpated or extinct; to provide for the recovery of species that are extirpated, endangered, or threatened; and to manage species of special concern to prevent them from becoming further at risk. Schedule 1 is the official list of wildlife species at risk in Canada. Once a species is listed as extirpated, endangered, or threatened on Schedule 1 under the SARA, it becomes illegal to kill, harass, capture or harm it in any way. Critical habitats are also protected from destruction. As defined in SARA, critical habitat is the habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in the recovery strategy or in an action plan for the species.



Source: CAPP et al. 2005

Figure 2: Schematic of Typical Punch and Bore Drilling Technique

Once a species is added to the list and protected officially under SARA, a recovery strategy must be developed. As a first step towards protecting wildlife species at risk and listing under SARA, species are assessed by the Committee on the Status of Endangered Species in Canada (COSEWIC) (SARA sec 14 and 15).

Operational Statements were originally developed for low risk projects when considering the potential impacts of works and undertakings under the *Fisheries Act*. While the *Fisheries Act* and SARA have similarities, there are several different, and often more stringent definitions and requirements within the *Species at Risk Act* than found in the *Fisheries Act*. For example, the term "activity" as used in sections 73 and 74 of SARA has a broader meaning than does "works and undertakings" as found in section 35 of the *Fisheries Act*; however, works or undertaking does fall under the term of activity in SARA (DFO 2007c). Consequently, when regarding areas and species related to SARA implications, additional considerations may be required.

As outlined in the *Practitioner's Guide to Species at Risk* (DFO 2007c), SARA was to be integrated into the OS by Habitat Management (HM) staff through review of the OS prior to

release to the public. This was to ensure the OS do not contravene SARA prohibitions; they are consistent with the recovery objectives for the species and/or its critical habitat; and if an OS is found to pose risk to the aquatic species at risk in a particular geographic area, the area is removed from the OS (DFO 2007c). At the time of publication, the latest version of the OS for trenchless crossings in Alberta on the national DFO website for use by proponents and the general public is dated March 31, 2008. Little to no assessment of many of the OS have taken place and the only formal assessment of the potential threats of trenchless crossings within SAR habitat in Alberta was completed in the summer of 2010 as a part of this project. There has been limited directed oversight of any of the specific OS by the Habitat Management Program in the last few years.

In Alberta, there are only two fish species currently listed under the *Species at Risk Act*, both from the extreme southern regions of the province. Consequently, many proponents have not had extensive exposure to SARA. At the time of completion of this document, the two fish species listed on Schedule 1 of SARA in Alberta are the Rocky Mountain Sculpin (*Cottus* sp.) and the Western Silvery Minnow (*Hybognathus argyritis*), both listed as threatened. These species were considered in this monitoring project along with two other fish species designated by COSEWIC: Lake Sturgeon (*Acipenser fulvescens* - endangered), and Westslope Cutthroat Trout (*Oncorhynchus clarkii lewisi* - threatened). For an updated list of the SARA and COSEWIC listed species in Alberta, please refer to the Species at Risk website: (http://www.sararegistry.gc.ca/sar/index/default_e.cfm).

The Rocky Mountain Sculpin has a very limited distribution in Alberta and is confined to the St. Mary River and the Milk River systems of southern Alberta (COSEWIC 2005). It is nocturnal and forages and feeds at night, mostly on bottom dwelling invertebrates (COSEWIC 2005). This species is considered threatened as it is at the northern spatial limit of its range and it is susceptible to threats of water diversion and flow modification (COSEWIC 2005).

The distribution of the Western Silvery Minnow is limited to the main stem of the Milk River system in Southern Alberta. It is usually found in the backwaters and pools of larger, northern streams of the plains and has adapted to a system with a high sediment load and naturally fluctuating flow conditions (Milk River Fish Species at Risk Recovery Team 2007). The main threats to this species are similar to that of the Rocky Mountain Sculpin and include water diversion and flow modification (Milk River Fish Species at Risk Recovery Team 2007).

The Westslope Cutthroat Trout (WSCT) is found in the South Saskatchewan drainage system in south western Alberta (COSEWIC 2006a). This species is well understood in terms of its life history and threats in Alberta. The WSCT has a preference for cold, clean, oxygen rich water and typically/primarily occupies small, higher elevation streams which are often dependent on groundwater upwellings to support oxygenation of eggs and prevent areas from freezing to the ground (COSEWIC 2006a). These groundwater upwelling areas are therefore likely critical to the survival of the species, particularly for survival overwinter. Groundwater upwelling areas may be ice-free during severe temperatures and key in the persistence of fish using them (Brown 1999). This habitat is of concern when trenchless crossing methods are utilized due to the potential disruption of important groundwater upwellings. The trenchless techniques are not intended to be used in such areas, as

explained in the OS, however, it is unclear whether or not drilling operators are aware of the presence of groundwater upwellings and habitat needs of the salmonid species therein.

The geographic area examined for this study is broader than the current distribution of the pure strain WSCT in Alberta. The area chosen is more in line with the historical range as the current range is only approximately 18% of its historical occupation in the extreme headwaters in southwestern Alberta (DFO 2009). It is unlikely that many trenchless watercourse crossings would occur in those limited locations. Also, it is possible that in order to recover the Alberta population of Westslope Cutthroat Trout, some watersheds within the historical range may require rehabilitation for the reintroduction of the species (DFO 2009).

The final species of interest, the Lake Sturgeon, is a long lived benthic feeder that occupies large river systems in Alberta (COSEWIC 2006b). This species can be expected to live up to 80 or 100 years, so there are aspects of its life history still being researched and as of yet, unknown. However, it is known that the Lake Sturgeon exhibits strong fidelity to spawning sites and may travel over 100 km to return to the same spawning sites time after time (COSEWIC 2006b).

For species that are listed as threatened on Schedule 1 of SARA, such as the Rocky Mountain Sculpin and the Western Silvery Minnow, critical habitat (CH), when defined in a recovery strategy and published on the Public Registry, becomes a concern for proponents proposing to do work in those areas (DFO 2007c).

This assessment of trenchless pipeline crossings in SARA and COSEWIC habitat within Alberta was conducted to determine if these crossings could be considered a higher threat in species at risk (SAR) habitat. More needs to be understood in relation to projects which could potentially destroy CH, as defined under the Act. A closer look into activities taking place within areas of known aquatic SAR is warranted to determine whether an activity may present a threat to destroying CH, for example whether or not these activities pose a threat to CH for the Rocky Mountain Sculpin or the Western Silvery Minnow. For the Lake Sturgeon and the Westslope Cutthroat Trout, such information could assist with the threat assessments for the species and for future SARA listing decisions.

The overall intent of this exercise was to determine whether the COSEWIC species and species protected under SARA prohibitions (i.e., the protection of aquatic species at risk, their residence (where appropriate), and their critical habitat) are being adequately protected when trenchless crossings Operational Statements are applied.

There were several specific objectives associated with this project:

1. Review of the Operational Statement notifications in PATH to determine the number of trenchless crossing OS notifications for the province of Alberta. Determine how many of those notifications fall within the range of SARA and COSEWIC species to determine the level of threat to those species.
2. Attempt to determine if the requirements of the *Species at Risk Act* are being met with the use of trenchless OS within aquatic SAR habitat. Upon reviewing that information, make recommendations on the use of this OS in Alberta and the Prairies.

3. Use the lessons learned in the assessment to make recommendations on corrective measures and/or improvements in the monitoring of SARA sites in the Prairies.

METHODS

PRELIMINARY SITE SCREENING AND SELECTION

A preliminary site screening and selection of sites for monitoring of trenchless water crossings in Alberta was carried out. This included:

- Determination of the number of trenchless crossings entered into PATH.
- Determination of the overlap between trenchless crossings and known SAR occurrence range.
- Selection of the sites to visit based on presence in SARA/COSEWIC species range and proximity to sites in a common area (to maximize effort). Any new notifications received during the summer of 2010 were input into PATH, assessed for proximity to the species at risk range, and added to the field assessment list if they fell within the appropriate range.

During this time, equipment was tested, protocols were formulated and developed, and safety equipment assessed for completeness prior to field use.

In order to gain insight into the frequency of trenchless crossing methods, an audit of all the trenchless crossings entered in PATH was completed for the province of Alberta for the period between 2005 to the summer of 2010. This audit was based on data that were voluntarily provided, therefore the actual number of crossings may be higher as DFO may not have received notifications from all proponents.

The file locations were mapped as in Figure 3 to determine which sites were overlapping the known habitat of Western Silvery Minnow, Rocky Mountain Sculpin, Westslope Cutthroat Trout, and Lake Sturgeon. The sites mapped on this figure show just over 500 locations of the total 1413 as only approximately one third of the OS had UTMs on the file which could result in mapping directly from the data set. Certain geographic areas were automatically removed from the exercise, reducing the number of points in the data set. For example, all files from Northern Alberta were eliminated as none of the points fell within the area of interest. For simplicity, the remaining points were then subdivided into three areas based on habitat and/or species type within the areas. The number of files was then narrowed down from 1413 to approximately 200 by removing the sites not in the vicinity of the interest area.

Figure 4 shows the areas of interest from a SARA and COSEWIC perspective. There were three areas of consideration for this project - the southern region, the North/South Saskatchewan River system, and the Foothills area. These three areas support different species and are geographically separated:

- The southern region includes the Milk and St. Mary River systems. These rivers are known to support Rocky Mountain Sculpin and Western Silvery Minnow.
- The North and South Saskatchewan River system is home to Lake Sturgeon and is typified by large river systems with significant flows.

- The final area is confined to the Foothills area, which extends from Calgary west to Banff National Park and extends down as far as the U.S. border and is home to the Westslope Cutthroat Trout. The habitat in this area is typically cold, clear, and contains a diversity of habitat types.

Two-thirds of the files were found to be lacking UTM coordinates or location information. Once the files were narrowed down based on broad geographic locations, files without UTMs or locations were manually pulled from the DFO offices in Lethbridge, Calgary, and Edmonton to determine a closer proximity of the crossings to the areas of interest. The information was either determined by the physical file or the proponents were contacted for location clarification. This information was then compiled and mapped if within the interest areas. When all files were analyzed, including 'as received' notifications in the 2010 field season, there were a total of 30 potential crossing sites grouped within the SARA or COSEWIC areas of interest. This equates to approximately 2.1% of the notifications received in Alberta for trenchless crossing.

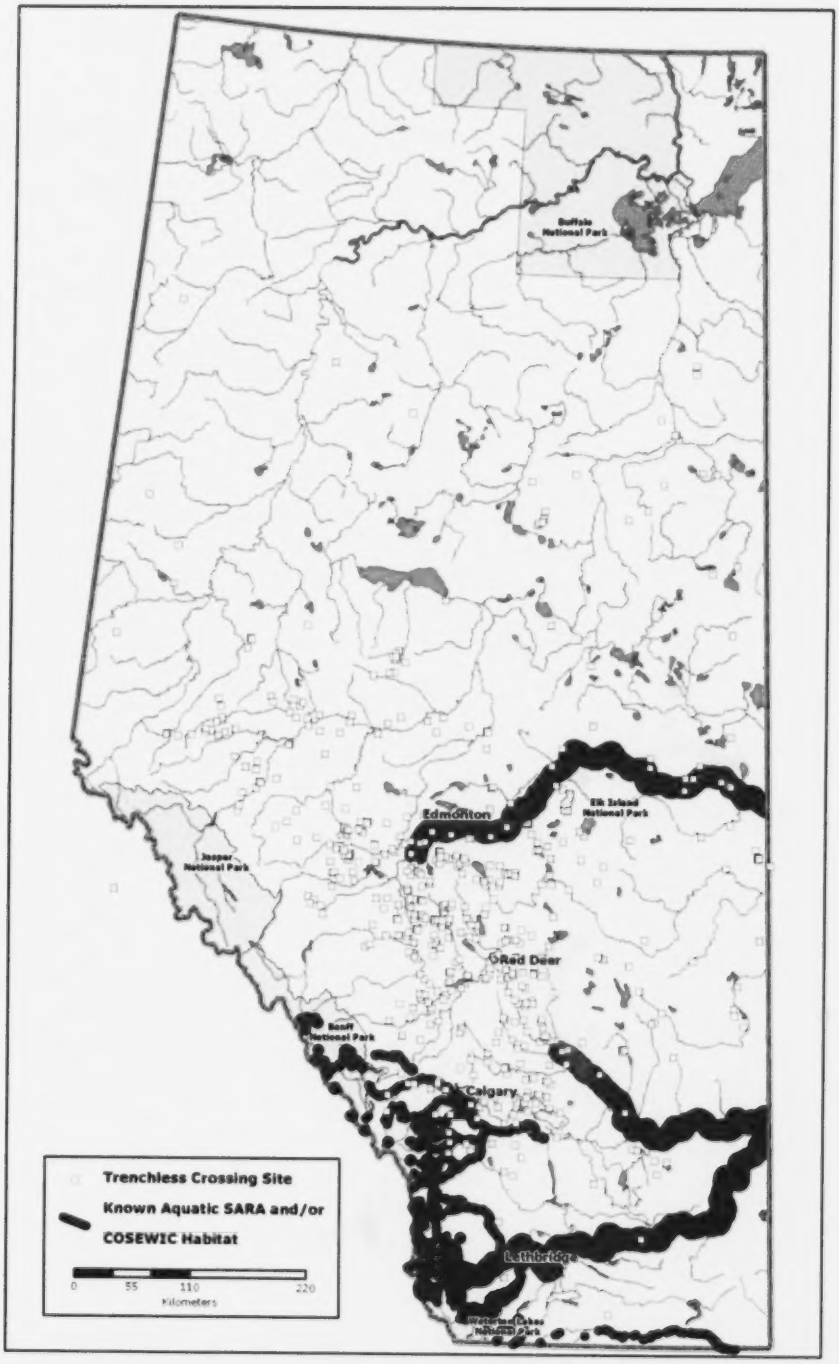


Figure 3: Location of Trenchless Crossing Sites (2005-2010) as Compared to Known Aquatic SARA and COSEWIC Species Habitat in Alberta

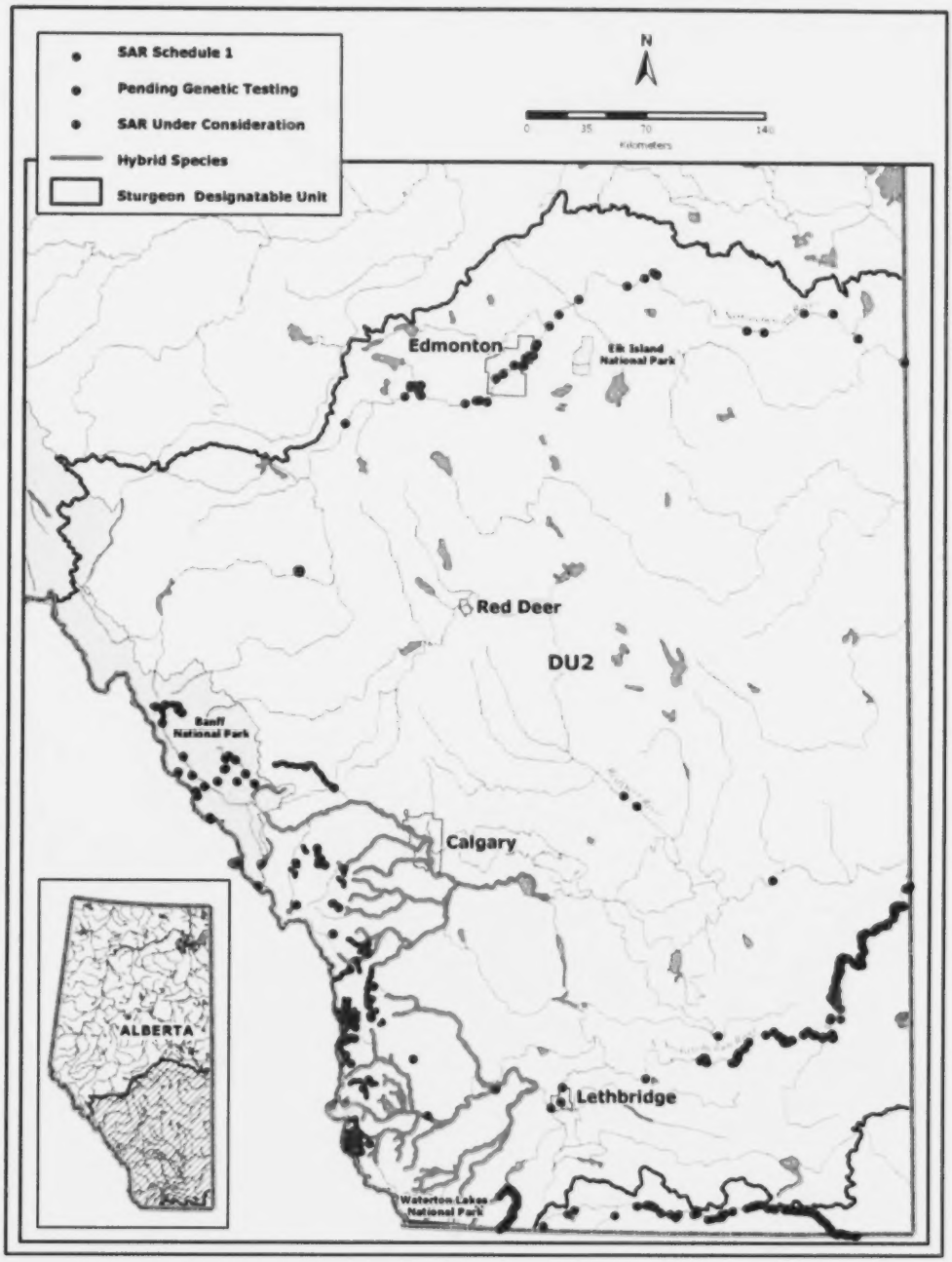


Figure 4: Areas of Interest from a SARA and COSEWIC Perspective

Site Assessments

The site assessments included:

- trial runs to ensure equipment and protocols were measuring expected results
- assessment for compliance with conditions set out in the OS
- environmental data and habitat measurements for each site
- where applicable, compliance and effectiveness monitoring

The trenchless stream crossing assessments in aquatic SAR habitat were conducted between June 10, 2010 and September 2, 2010. At each crossing location, either a High-pressure Directional Drilling Monitoring Form or a Punch and Bore Monitoring Form (Appendix 4) was completed. These Monitoring Forms were adapted from the Monitoring Forms developed for the Central and Arctic Area from the templates provided with the *Practitioners Guide to Monitoring and Evaluation of Operational Statements 2007/2008* (DFO 2007d). This guide was produced in 2007 to assist with the evaluation of the effectiveness of the OS, compliance with the mitigation measures outlined in them, and to provide input to future improvements. The forms were modified slightly to include a section pertaining to the species at risk component of this project.

Along with the observations taken as a part of the standardized Monitoring Forms, each crossing site location was surveyed and physical parameters and disturbances to the location were measured. The survey methods were primarily adapted from the *Alberta Transportation's Fish Habitat Guidelines* (Alberta Transportation 2001) and specifics are outlined in Appendix 5.

RESULTS AND DISCUSSION

PRELIMINARY SITE SCREENING AND SELECTION

The original PATH search resulted in a total of 1413 trenchless crossing notifications for consideration in Alberta since the implementation of the Operational Statements in 2005 to the end of summer 2010.

The potential monitoring sites were reduced by overlaying the points onto maps with the areas of interest mapped. This further reduced the number of potential sites within the areas with the SARA and COSEWIC listed species. Some of the trenchless crossing files within potential areas of interest did not contain any legal land or UTM information (42) and some only contained information on the legal land description (68). These files had to be pulled manually from the office of interest to determine if they were within the scope of this project. After all the screening was completed, a final data set composed of 30 potential sites was compiled.

In keeping with the area separation due to physical differences in the habitat types and separation of areas within Alberta, the areas have been split up for results analysis. Table 1 provides a summary of the geographic locations. Please see Figure 5 for an overview of the final sites that were examined during this project. Appendix 6 summarizes various parameters for the locations which were taken during the site visits.

Table 1: Summary of Geographic Locations for Field Assessment

Geographic Location	Characteristics	Species of Interest
Southern Alberta: Milk River and St. Mary River	Extreme southern Alberta distribution	Rocky Mountain Sculpin Western Silvery Minnow
North and South Saskatchewan River Systems	Shallow areas of large rivers and lakes within the North and South Saskatchewan Systems	Lake Sturgeon
Foothills Area (Calgary to Banff/south to the U.S. border)	Areas of low perturbation with cool, clean, clear water and varied habitat characteristics present	Westslope Cutthroat Trout

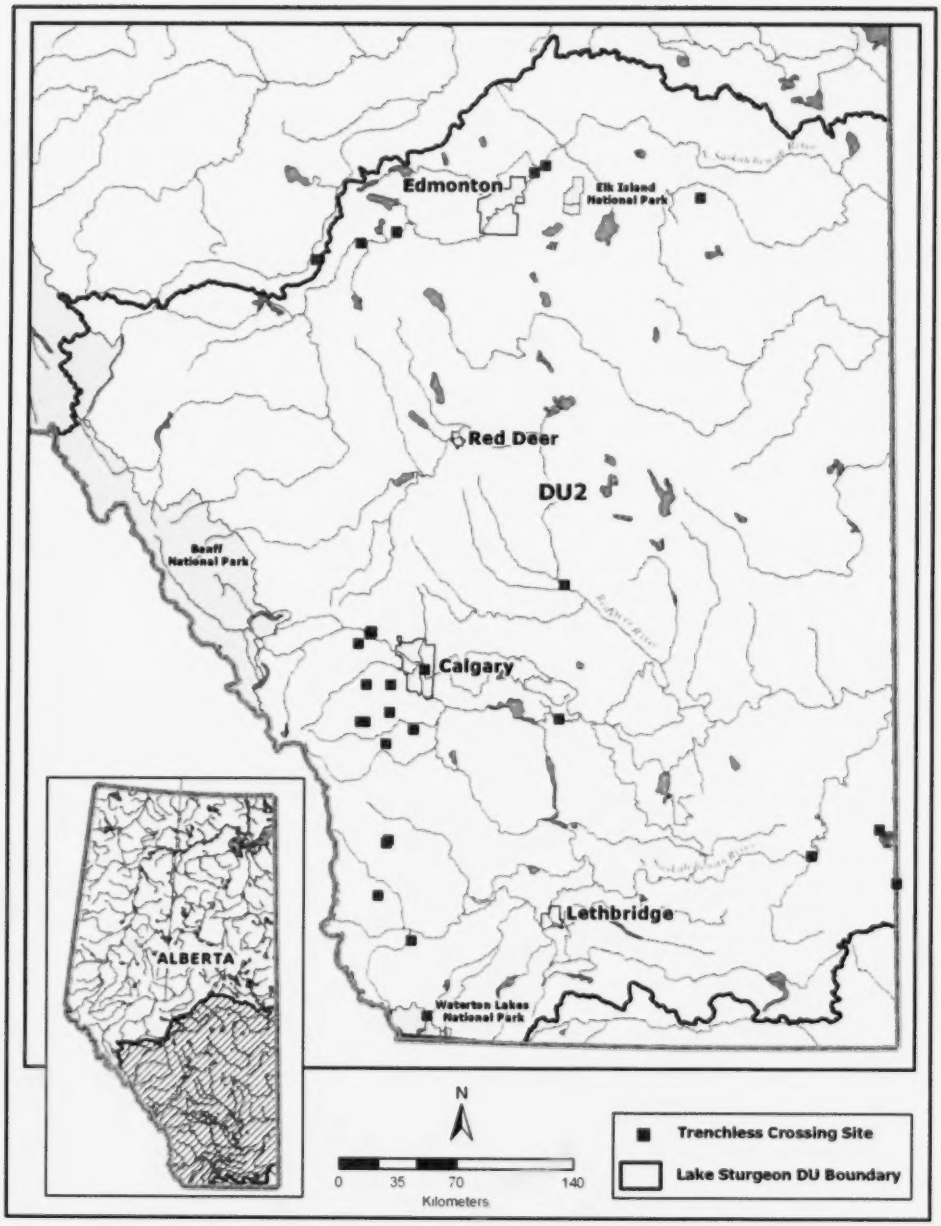


Figure 5: Final Monitored Sites

Files in the Saskatchewan River System

In the habitat occupied by Lake Sturgeon, only eleven potential sites were in our list for monitoring. Of these 11, upon completion of the site assessment, it was determined only 8 sites were suitable Lake Sturgeon habitat due to lack of water depth and little to no significant flow from the river system's main stem in the other three sites. Figure 6 shows the location of the Lake Sturgeon trenchless crossing locations. Figure 7 illustrates a site typically associated with Lake Sturgeon habitat in the South Saskatchewan River. For comparison, Figure 8 shows a site attended during the project, illustrating very poor quality habitat for Lake Sturgeon.

Of the sites crossed in the areas in the vicinity of the Saskatchewan Rivers, five were crossed using the high-pressure directional drill method and three were crossed using the horizontal bore/punch. Although the HDD was used for more crossings, there was not a significant preference of one type over the other in this area.

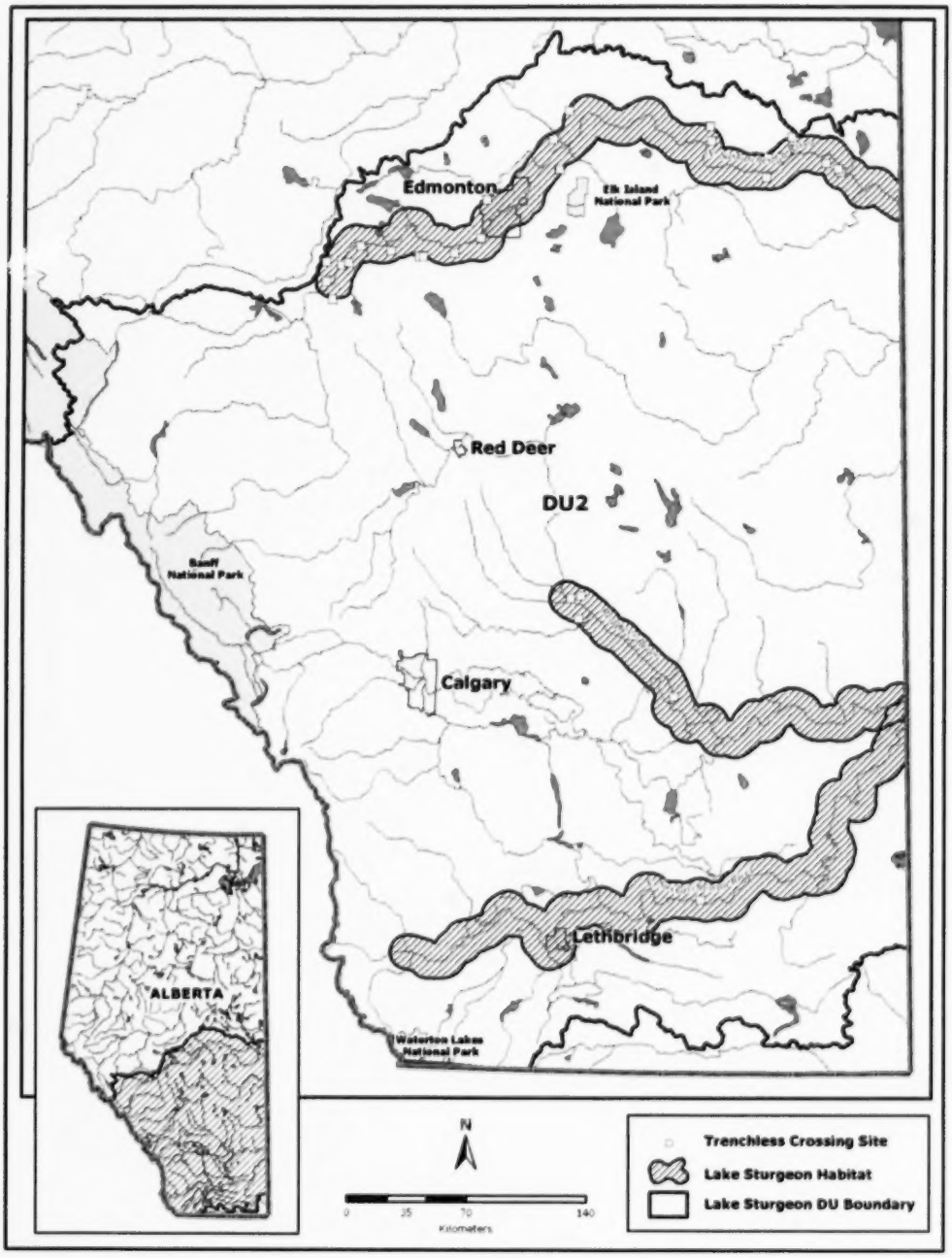


Figure 6: Location of Trenchless Crossings in Lake Sturgeon Habitat Areas

Figure 7: Lake Sturgeon Habitat South Saskatchewan River, Alberta

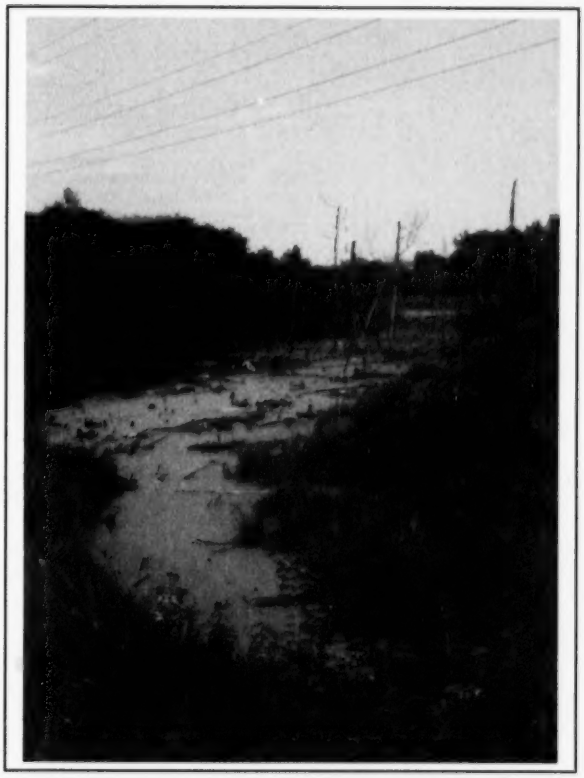


Figure 8: Unsuitable Lake Sturgeon Habitat – Saskatchewan River System Site Excluded from Study

Files Relating to the Areas of Southern Alberta (Milk And St. Mary River Systems)

During the site screening and selection process, it was noted that very few trenchless projects are typically undertaken in this area of Alberta.

Table 2 provides an overview of the number of OS and trenchless water crossing notifications by DFO office. It is important to note these numbers reflect all the trenchless crossings in Alberta from the introduction of the OS to the end of 2010, thus the number of notifications in this table are much higher than the 1413 number referred to throughout this document. The reason for this was the analysis for this project was done in the winter after the completion of the project. The end of the year was thought best to give a more true representation of the actual numbers per office as often project notifications are received on a seasonal basis.

The Lethbridge office (located in the southern Alberta Area), has far less incidence of any type of OS including the fewest notifications of trenchless crossings within the province (Table 2). This may help to explain why no trenchless crossings were found in the watercourses occupied by the Rocky Mountain Sculpin and the Western Silvery Minnow. In Lethbridge:

- Of the 49 HDD notifications, none were found in the regions of the St. Mary or Milk River.
- Of the 63 bore/punch crossings, only one was found near either the St. Mary or Milk River. There was one Bore/Punch Notification that related to a tributary to the Milk River but outside the project scope.

Table 2: Number of Operational Statement Notifications by DFO Office in Alberta 2005 - December 2010

Office	All OS Notifications in PATH to the end of 2010	High-pressure Directional Drilling Notifications	Bore and Punch Crossing Notifications	More Common Trenchless Crossing
Lethbridge	244	49	63	Punch/Bore
Calgary	1165	190	381	Punch/Bore
Edmonton	2635	301	666	Punch/Bore
Peace River*	1381	153	204	Punch/Bore

*Peace River was not part of the monitoring area because it fell outside of the area of interest; however, for comparison of number of OS in each Alberta office, it was included here.

Based on these findings, the number of trenchless crossings are minimal in this area and thus are not likely a major threat to aquatic SAR in the Milk and St. Mary River systems. The southern Alberta (St. Mary and Milk River region) area was ultimately removed from the project review as there were no trenchless crossing sites within the area.

Files Relating to the Foothills Area

The Foothills area saw by far the bulk of the trenchless works of all the SARA and/or COSEWIC areas. Of the 30 total sites assessed for this project within at risk habitat, 19 were within this area. Upon examination, only one of these sites was unlikely to provide the adequate life history requirements of the WSCT and was considered to show little habitat potential. Therefore, within this region, 18 sites showed adequate potential to support the life history requirements for the WSCT for at least part of its lifecycle.

Of the works completed, 13 of the sites were crossed using the high-pressure directional drill technique while the other 5 in WSCT habitat were crossed using horizontal bore/punch. The high-pressure directional drill method was by far the most commonly observed method for the habitat in this area for the sites associated with the assessment.

In summary, of the thirty sites attended during this threat assessment, a total of 26 were considered within areas of SARA or COSEWIC habitat. Often it can be difficult to gauge the quality of the habitat until the site visit. This is particularly true when assessing sites located using legal land locations which can be within a 2 km radius from the site itself. For example, a site may turn out to be a small tributary to a river when the expected location may have been the river's main stem. Of these 26 validated habitat sites, a total of 18, the vast majority, were within the Foothills region of Alberta, habitat to the WSCT. The other 8 occurred in either the North or South Saskatchewan River system. Other trenchless crossings may have occurred in these areas but are not represented in this project as the proponent (i) did not choose to submit a voluntary OS Notification Form to DFO or (ii) the trenchless crossing was captured under a larger project application and was not submitted under a OS (i.e., may have been captured under an application for works or undertakings likely to cause a harmful alteration, disruption, or destruction of fish habitat (HADD)). The PATH searches in this project were solely concerned with the OS designation within the database and did not focus on other project types which may have captured additional sites. Table 3 summarizes potential and actual sites by area and trenchless crossing type.

Table 3: Summary of Assessment Sites by Area

Geographic Location	Number of Potential Sites	Number of Actual Sites and # active	Type of Trenchless Crossing
Southern Alberta - Milk River and St. Mary River	0	0	-
North and South Saskatchewan Rivers	11	8 (1 active)	5 HDD 3 Bore/Punch
Foothills area (Calgary to Banff)	19	18 (1 active)	13 HDD 5 Bore/Punch

SITE ASSESSMENTS

Site assessments were carried out between June 10 and September 2, 2010. Appendix 6 provides a summary of the assessed sites. Of the 26 sites confirmed to be located within SARA/COSEWIC habitat, only 2 of those sites were active during the assessment, one on the Red Deer River in the South Saskatchewan River system, the other on Fish Creek, in the Foothills area.

ACTIVE SITES

Saskatchewan River System

An active site on the Red Deer River (South Saskatchewan River system) was observed on July 7, 2010. This pipeline was installed using a high-pressure directional drilling technique (Figure 9). The photo clearly shows the gray liquid (the drilling mud) which can be harmful to fish and fish habitat. However, in this case, the drill was successful and installed far from the edge of the watercourse with no impacts to the river (Figure 10).

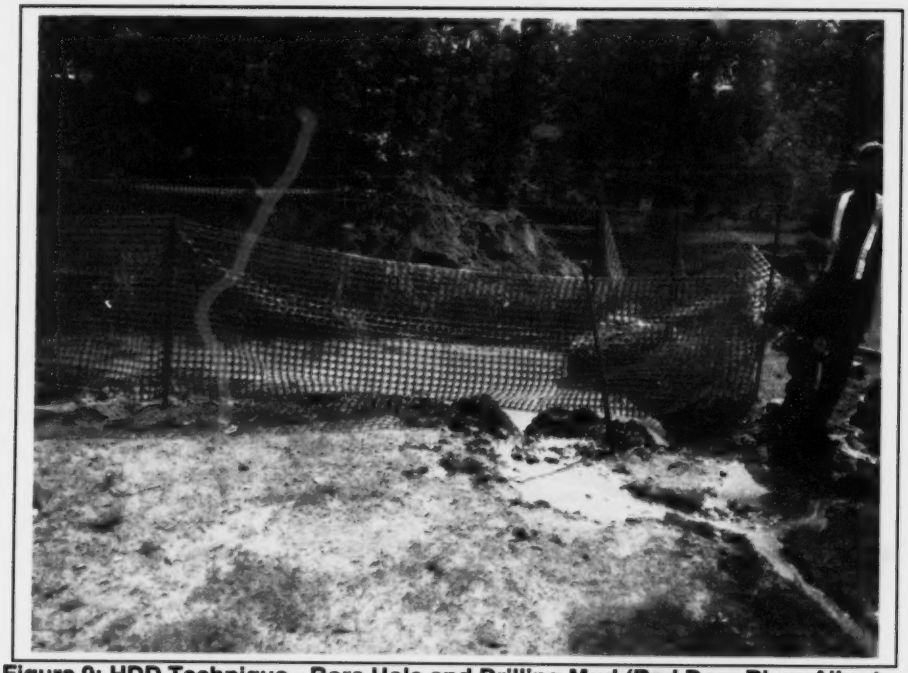


Figure 9: HDD Technique - Bore Hole and Drilling Mud (Red Deer River Alberta, South Saskatchewan River System, July 2010)

Figure 10: HDD Technique - Location of Bore Hole with Respect to the River (Right Of Way Boat Launch, Red Deer River Alberta, July 2010)

Foothills Area

A second active site was attended on September 2, 2010. This was a high-pressure directional drill for a crossing of Fish Creek, in the Foothills area. This is the type of habitat that is typically seen for the Westslope Cutthroat Trout. Figure 11 illustrates the clear water with cobble substrate one would expect in salmonid habitat. Some maintenance work was completed at this site, as an old pipe had shifted and become exposed to the elements (Figure 12). This pipe was removed. Figure 13 shows the upland excavation of the pipeline required as a part of the removal process.

Figure 11: Westslope Cutthroat Trout Habitat (Fish Creek Alberta, Foothills Area, September 2010)

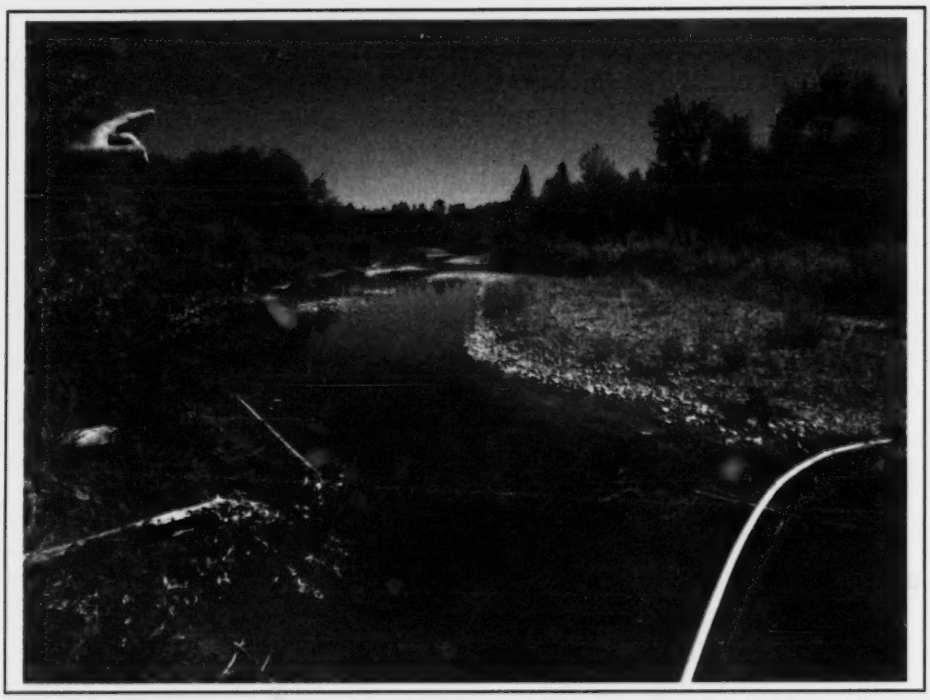


Figure 12: Old Exposed Pipeline – Right of Way Downstream (Fish Creek Alberta, September 2010)

Figure 13: Old Pipeline Removal (Fish Creek Alberta, September 2010)

It is interesting to note that both active installations showed non-compliance with the conditions and mitigation measures outlined in the OS for high-pressure directional drilling. The OS requires the proponent to have an emergency frac-out response plan in the event of drilling mud spill and specifically states "Keep all material and equipment needed to contain and clean up drilling mud releases on site and readily accessible in the event of a frac-out." (Measure 8 of Measures to Protect Fish and Fish Habitat). The OS also requires an emergency spill-kit be kept on site in case of machinery leaks and spills into the water course (Measure 5.3). Neither of the active sites attended during the 2010 field season had a spill-kit on-site or easily accessible in the event of a frac-out.

NON-ACTIVE SITES

Foothills area

Within the sample set of 19 sites in the Foothills area, two sites (Ware Creek and Three Point Creek) showed evidence of non-compliance with the OS. These sites showed evidence of vegetation removal and potential of wet crossing/trenching of the creeks. The OS prohibits the use of techniques which could negatively impact the fish and fish habitat, damage the riparian vegetation, and specifies that the crossing is not to be an open cut crossing.

As seen in Figure 14, there is strong evidence of vegetation removal at the crossing site on Ware Creek in the Foothills region. If one were to assume the vegetation removal and creek disturbance visible in the photos were part of the pipeline installation, then this project would be in non-compliance with the requirements of the OS and depending on the extent of the damage/alteration to the fish habitat, could be considered a HADD of fish habitat.

Figure 15 shows the second impacted creek, Three Point Creek. In this instance, there is riprap placement on the creek bed and shoreline and evidence of riparian vegetation removal. This site could be in non-compliance with the requirements outlined in the OS if these works are a part of the pipeline installation outlined in the OS notification received by DFO. Depending on the extent of the alteration/damage to the habitat, this project could be considered a HADD of fish habitat.

Jumping Pound Creek, also found within the Foothills area, had an HDD installation completed in 2007. Figure 16 shows an exposed pipeline that was located near the vicinity of the right-of-way (ROW) at the watercourse. The significance of maintenance issues with the pipelines is sometimes overlooked and it may be worth considering the effects of these issues on fish and fish habitat. If pipelines such as this were to rupture, considerable damage to the resource may result. Further investigation into these effects should be undertaken to ensure that species that are more sensitive to impacts to their habitat are adequately protected from potential break or rupture of pipeline crossings.

Table 4 provides a summary of the sites found to have evidence of non-compliance or maintenance issues.

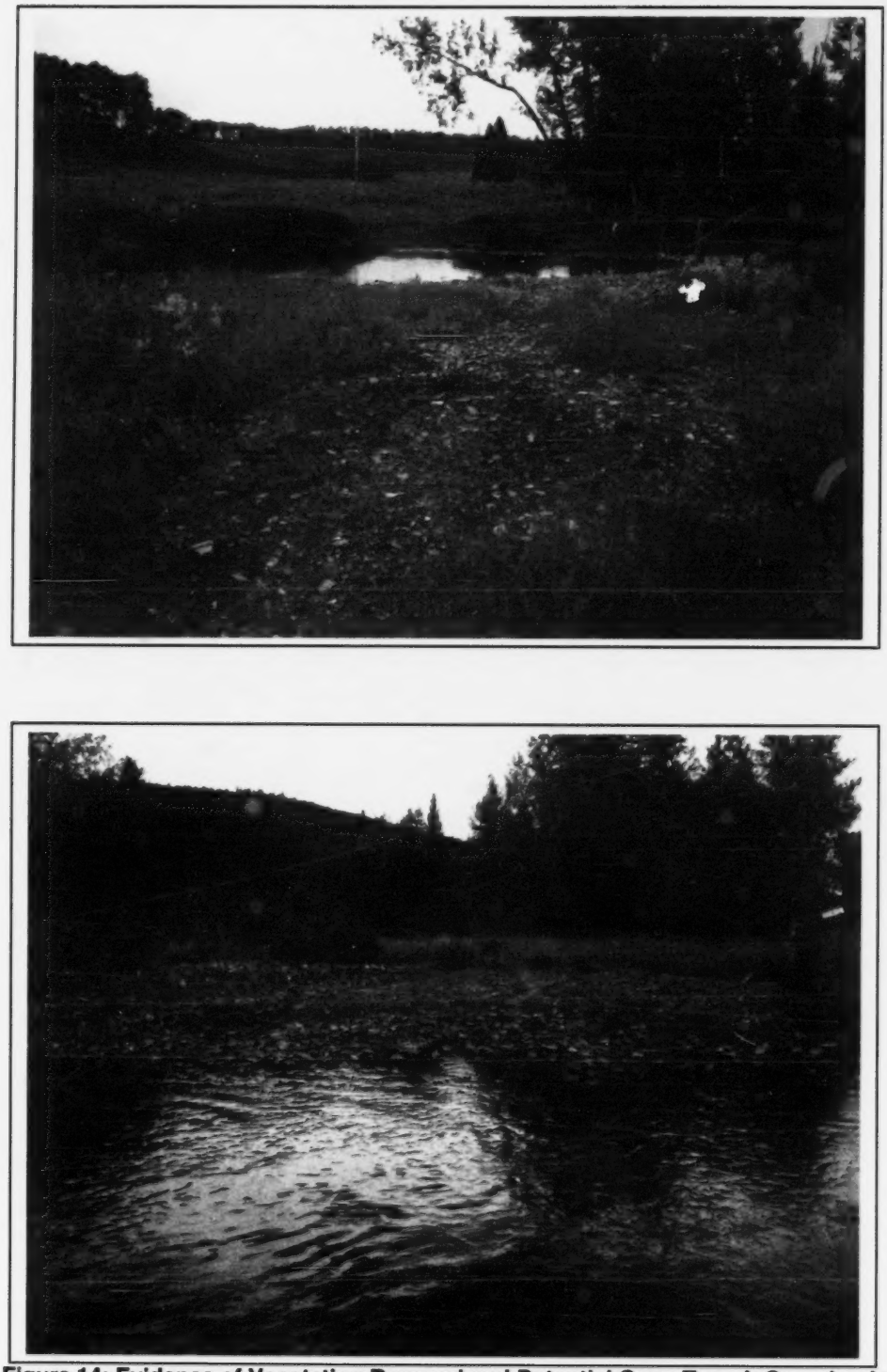


Figure 14: Evidence of Vegetation Removal and Potential Open Trench Crossing in Non-compliance with HDD Trenchless Crossing (Ware Creek Alberta, Foothills area, July 2010)

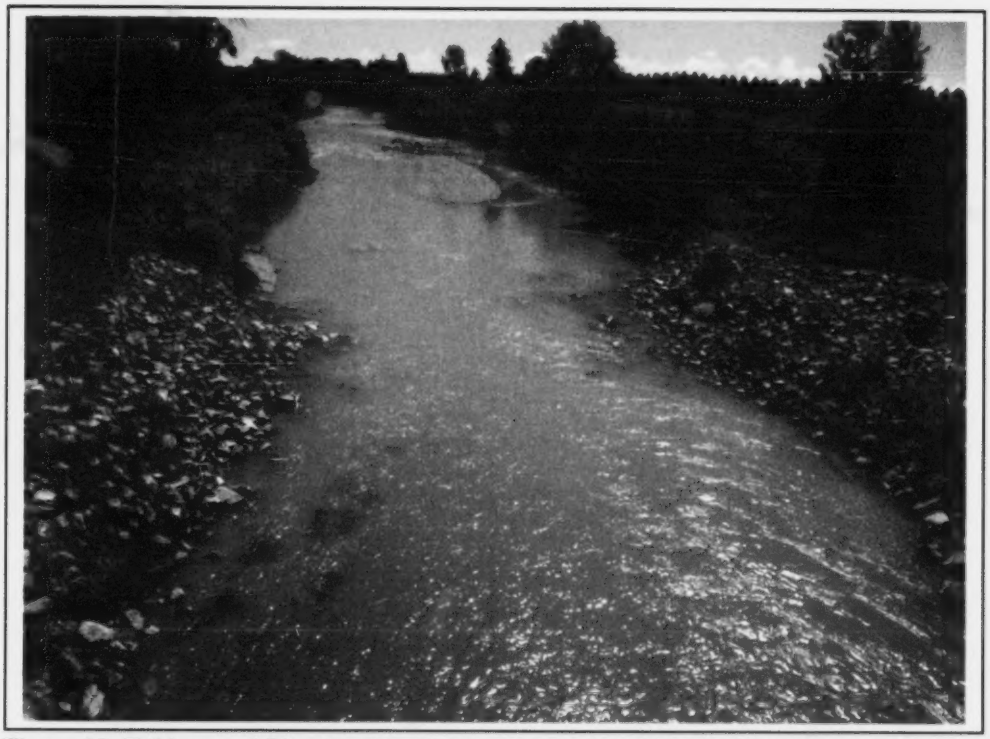


Figure 15: Evidence of Riparian Vegetation Removal and Riprap Placement on Creek Bed (Three Point Creek Alberta, Foothills Area, Downstream From Bridge, July 2010)

Figure 16: Exposed Pipeline Upstream from Right of Way (Jumping Pound Creek Alberta, July 2010)

Table 4: Summary of Sites with Evidence of Non-compliance or Maintenance Issues

Watercourse Crossing	Typical Habitat of WSCT or LS	Maintenance Issue	Habitat Issues
Foothills Area			
Big Hill Creek	Westslope Cutthroat Trout		Frac-out: due to multiple frac-outs with the site they were considering other methods for another attempt during the summer of 2010. Fluids did not appear to be present in the watercourse.
Three Point Creek	Westslope Cutthroat Trout		Evidence of trenched crossing: riprap installed; exposed geotextile under the rock. Also evidence of willow staking and some regrowth.
Ware Creek	Westslope Cutthroat Trout		Evidence of trenched crossing: the right of way highly disturbed; the area was not re-vegetated and covered in fines, gravel and cobble resulting in some sedimentation.
Jumping Pound Creek	Westslope Cutthroat Trout	Exposed Pipe noticed approximately 8 m from the right of way (ROW) (Figure 16).	
Fish Creek	Westslope Cutthroat Trout	Exposed pipeline at the right of way (ROW) (Figure 12); this was removed at time of site visit.	Emergency preparedness: no spill kit onsite during works.
Saskatchewan River Systems			
Bow River-Taber	Lake Sturgeon		Frac-out: three fracs reported but no evidence at time of site visit; deep water and large river site.
South Saskatchewan River	Lake Sturgeon		Frac-out: within the file; DFO was notified at time of construction; no evidence at time of site visit.
Red Deer River	Lake Sturgeon		Emergency preparedness: no spill kit onsite during works. Reportedly there was a spill kit available at a crew location approximately 2 km away from the watercourse crossing site.

RECOMMENDATIONS

Following the review of trenchless crossing projects in SARA and COSEWIC habitat in Alberta, two key recommendations were formed:

1. It is recommended the OS do not apply in the southern Foothills area of Alberta. This recommendation is due to the lack of spill-kits present on active sites and the evidence of non-compliance with the OS. Although only two active sites were included in the assessment, both of these sites were without spill kits. The reasons for this

recommendation include the aforementioned evidence of risk to the aquatic species and the high volume of crossings occurring in the Foothills region relative to other aquatic species at risk areas and the sensitivity of the habitat to disruptions in groundwater upwelling.

2. It is recommended that proposed trenchless crossings are assessed on a case-by-case basis to ensure the projects are meeting the requirements of SARA in the other areas where SARA and COSEWIC species occur in Alberta. Given the low volume of files within these at risk areas (30 files out of 1413 files were within at risk habitat up to the summer of 2010), this would not substantially increase the workload for habitat management staff within a given office.

Several recommendations for aquatic species at risk areas have been compiled in different locations relating to the HM Monitoring Program including the OS Notification Forms, the use of Trenchless Operational Statements, and the Habitat Management Program Monitoring Forms. Each issue is discussed separately below. Education needs and pipeline maintenance issues are also discussed.

Operational Statements

Operational Statement Notification Forms

As a part of the OS notification process, the proponent is asked to provide DFO with a completed Notification Form for the works in question (Appendix 1). Based on the findings of this report, it is recommended these forms are updated to include the following:

- **The use of UTM coordinates** – UTM coordinates are preferred over the more commonly provided legal land description. It is recommended the UTM be made more prominent or be the only option for location of the project on the form to make it easier to find a given crossing location. Often it would take over an hour to locate a site in the field upon arrival in the general vicinity, when the location was based on a legal land description. A more precise location would potentially reduce time spent in the field and would save valuable time in locating a crossing if an infraction was anticipated. If a spill or frac-out occurs, an extra hour lag time can result in a much larger dispersion in a riverine environment.
- **Indication of previous submission of notification** – The inclusion of a check-box or area on the form to indicate whether or not this crossing notification had been submitted in the past. In this way, redundancies could be avoided or minimized in the database. It was found that in a small number of cases the notification was sent in for multiple years if the works did not occur due to scheduling or financial reasons. Although not a huge amount of redundancy, it would be helpful to reduce this doubling up of files in the database to improve the quality of the dataset.
- **Mention or consideration of the *Species at Risk Act*** – The operational reference to SARA is vague and could easily be overlooked on the Notification Forms. It is recommended that a more direct message about the *Species at Risk Act* be incorporated into the trenchless OS. Included within the OS should be an indication to the proponent that a case-by-case review is likely or is required in areas with aquatic species at risk.

Trenchless Crossing Operational Statements

- These forms should be reviewed and updated as the latest version has not been examined and re-posted on the national website since 2008. DFO should be revisiting the statements at least every two or three years to ensure the tenets of the statements are still valid and applicable. At time of printing, the website was due for an update.
- There are some parts to the Alberta statements which are unclear or somewhat subjective and may need to be revisited. An example of this can be seen with the following condition contained in both OS for trenchless crossings: "The site does not occur at a stream location involving known fish spawning habitat, particularly if it is dependent on groundwater upwelling". This is a very complicated process - are proponents expected to have this level of knowledge of fish habitat sites? Is it likely the operators of drilling equipment have this level of fish habitat knowledge? It seems this fairly complicated river dynamic would be difficult to assess in the field. It would be prudent to restrict usage of the OS for this type of activity in areas of known groundwater upwelling as these areas are often key spawning and overwintering areas for fishes (Heggenes et al. 2010). In addition, there are some areas that frac-outs are prone to occur due to land formation. Limiting use of these techniques in these areas should also be examined.
- The OS need to highlight the importance of having a spill-kit on the active work site. The importance of the emergency response plan needs to be made abundantly clear. This is of particular importance when referring to SARA listed species or to more sensitive species (such as COSEWIC designated or even provincially listed species) as a frac-out or spill in vulnerable areas could imperil the species even further if a quick and adequate cleanup is not done. The emergency response plan is mentioned in the OS, but given that neither of the two active sites observed had spill kits readily accessible, the importance of the emergency plan needs to be illustrated in a more prominent way to ensure compliancy. The Operational Statement needs to ensure that the need to reduce the risks associated with a spill event are clearly understood.
- Beyond the case-by-case assessment mentioned above, it is recommended that trenchless Operational Statements are not applicable in areas of WSCT habitat. This is due to the high volume of crossings (18 of the 26 sites assessed) within this area and the fact the fish in this area are very sensitive to changes in their environment. Salmonid species, such as the Westslope Cutthroat Trout, are often dependent on groundwater upwelling for refugia from various environmental conditions (Heggenes et al. 2010). It is reasonable to assume such areas could potentially be disrupted by underground crossing methods. It is suggested that maps be created and made available to the potential proponents, showing the removal of this corresponding area from the OS. The WSCT trout are being recommended for listing on Schedule 1 of SARA; however, in the interim, removing this geographic area from the trenchless OS would provide more protection to this sensitive species. There are also other sensitive salmonid species that are often found overlapping WSCT habitat and are also dependent on the groundwater upwelling, such as Bull Trout (*Salvelinus confluentus*) (ASRD and ACA 2009). Bull Trout has a status of sensitive within the province of Alberta and would also benefit from more stringent assessment of trenchless crossing activities in the Foothills area. At the time of printing this document the Bull Trout was scheduled for COSEWIC assessment in the fall of 2011.

General Operational Statements Considerations

- It is recommended that a review of all the Operational Statements for all areas be undertaken to determine the likelihood of them causing damage to aquatic species at risk and to assess the potential threats to the species critical habitat (where defined/applicable). This could be combined with an overall review of the OS content as the current versions have not been updated since 2008. This would ensure that the HM policy practice of using OS is meeting the stringent requirements of SARA.
- As critical habitat is formally defined for areas in Alberta and also for other provinces, maps and information will need to be made available and easily accessible to groups currently following the guidelines. Any major modifications of the existing documents will require an outreach and education program to update the public on any new requirements resulting from substantial OS revisions and/or changes.
- In addition, it may be useful if changes are made to the OS, to request the proponent submit a post-construction check list indicating if they have met the mitigation measures outlined in the OS. This could be accompanied with post-construction photos which would assist in determining if the OS are effectively protecting fish and fish habitat by giving a better picture of how the sites look after works are completed. This would also help DFO meet its monitoring requirements for lower risk projects not often assessed on the field level.

Monitoring Forms

It is recommended that the current HM Operational Statement Monitoring Forms (Appendix 4) are revisited and modified so they are more of a practical tool.

- Currently they contain very few areas to submit measureable data and many of the questions are subjective. It may be useful to have a measurements section for recording environmental data such as water depth; amount, type of riparian cover; and other site specific parameters for comparison with any future works or associated impacts in the area. For this monitoring project, a separate data sheet was utilized to record physical measurements as the HM forms did not provide this capability.
- In addition, the HM forms are quite lengthy which makes them cumbersome in the field.
- Finally, it would also be useful to have SARA species considered within the Monitoring Forms (e.g., include questions/sections on SARA species and CH). For the purposes of this monitoring project, the SARA aspects were added onto the existing forms as the current version does not accommodate SARA. Adding information about the Act into existing forms and tools will help provide some direction to staff on this topic.

EDUCATION

There is a lack of clarity around OS with respect to SARA species and associated critical habitat. In Alberta, the potential listing of species such as the Westslope Cutthroat Trout and Lake Sturgeon will result in new issues for the HM staff. Most HM practitioners in the province have not had much exposure to projects relating to species at risk. The information and education needs should be clarified internally as well as externally on the use of low risk policy tools beyond relating to the *Fisheries Act*. It is not clear in the DFO SARA *Practitioners Guide* (DFO 2007c) how the HM practitioner is to consider SARA in the review of low risk

activities. As such, it is more unlikely that an external client will understand the procedure for SARA considerations to do their due diligence as required by the Act.

The Practitioner's Guide to the Species at Risk Act (SARA) for Habitat Management Staff (DFO 2007c) states:

> "HMP has developed a series of national Operational Statements (OS) that describe measures to be incorporated into certain low risk development proposals in order to avoid the harmful alteration, disruption and destruction (HADD) of fish habitat. Proponents may proceed with their project without review by DFO when they implement all the measures outlined in a given OS and notify DFO of their plans. The OS have been developed for activities that are considered by DFO to be of low risk to fish or fish habitat. Each OS will be reviewed by Habitat Management practitioners to ensure that the activities would also not contravene the SARA prohibitions and are consistent with recovery objectives for the species, its residence or its critical habitat.
>
> The approach to integrating SARA into the OS will be for regional or area HM staff to review the statements (this may be done in conjunction with Science and the SARA representative), to ensure these conditions are met. Moreover, the OS will be periodically reviewed and updated by regional staff to ensure that they continue to protect fish habitat according to the *Fisheries Act* and SARA. If an OS is found to present any level of risk to aquatic species at risk in a particular region or area, a list of water bodies or areas where the OS does not apply will be included or listed in the OS. It should then be clearly stated in the OS that if the proponent is working in or around a water body listed in the OS, the OS does not apply and the proponent will be required to submit their project for review by DFO HMP."

As part of providing education pertaining to significant changes to be made to the OS and in accordance with the above:

- It is recommended maps be created and made available to the general public and potential proponents showing the removal of an area thought to have aquatic species at risk which may be put further at risk by a particular OS.
- Also, as there has not been a major change to the OS in several years, an active roll out is suggested. This may require public notices, presenting or giving workshops to industries and proponents on the new requirements/changes, and going through the areas which are no longer covered by the trenchless OS.
- HM staff would likely need similar information and presentations to ensure they know which areas may require a *Fisheries Act* review that used to be covered by the OS notifications. As providing notification to DFO for this process is voluntary, and given that DFO has not recently updated the OS, it is unlikely users of the OS will look to review the OS version they are currently using and therefore may not be aware of changes to the process. A more pro-active approach as mentioned above would therefore be prudent.

Pipeline Maintenance Issues

- It may be worthwhile to follow up on the ongoing maintenance and problems associated with underground pipelines. For example, conduct an investigation into the likelihood of pipelines becoming exposed when under a watercourse and, if exposed, review any available statistics on the probability the exposed pipe would rupture. It may be prudent to investigate whether different materials have varying life spans when

exposed to the elements. Given the areas of interest and the presence of sensitive species, the amount of ongoing maintenance and likelihood of failure could in itself prove to be a threat to species at risk and should be investigated further. A review of industry's best management practices for pipeline installation to obtain verification of required pipeline depths is likely a good place to start.

SUMMARY

Overall, there are issues with the use of the trenchless watercourse crossing Operational Statements in SARA and COSEWIC habitat in Alberta as indicated in the recommendations outlined in this report. In revisiting the current Operational Statements and Notification Forms, many of these problems can be addressed and resolved. However, for some sensitive areas, such as the foothills of Alberta, the method may not be appropriate due to vulnerable habitat. These areas should be removed from the Operational Statement applicable area. Corresponding maps and figures should be created to accompany the modified OS to provide clarity to both the public, with the focus on potential proponents and contractors, and to Habitat Management Practitioners.

ACKNOWLEDGEMENTS

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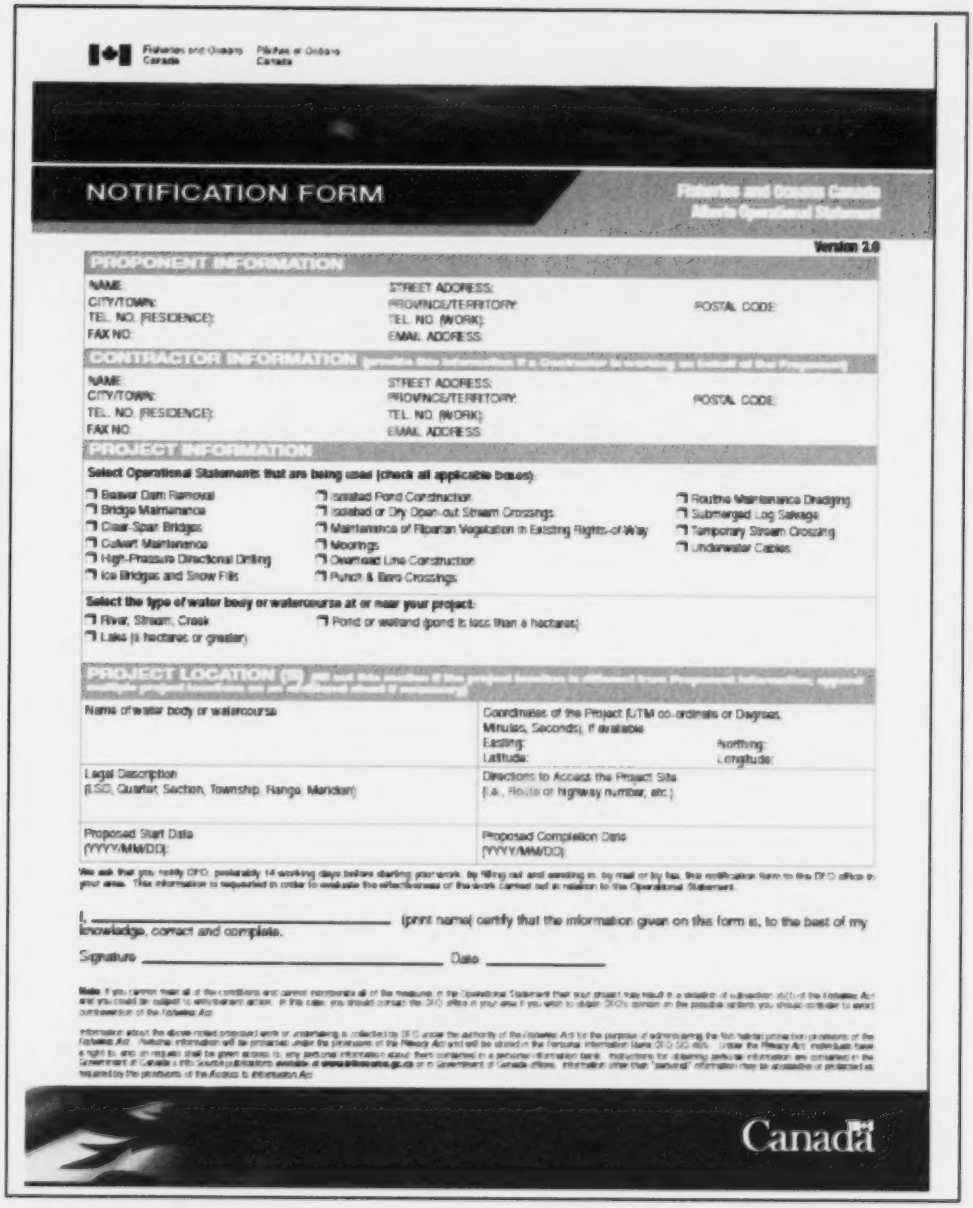
Heggenes, J., Bremset, G., and Brabrand, Å. 2010. Groundwater, critical habitats, and behaviour of Atlantic Salmon, Brown Trout and Arctic Char in streams. NINA Report 654. 28 p.

Milk River Fish Species at Risk Recovery Team. 2007. Recovery strategy for the Western Silvery Minnow (*Hybognathus argyritis*) in Canada. *Species at Risk Act* Recovery Strategy Series, Fisheries and Oceans Canada, Ottawa. viii+ 42p.

APPENDIX 1: DFO NOTIFICATION FORM (ALBERTA 2007)



Fisheries and Oceans Canada / Pêches et Océans Canada

NOTIFICATION FORM

Fisheries and Oceans Canada
Alberta Operational Statement

Version 2.0

PROPONENT INFORMATION

NAME:
STREET ADDRESS:
CITY/TOWN:
PROVINCE/TERRITORY:
POSTAL CODE:
TEL. NO. (RESIDENCE):
TEL. NO. (WORK):
FAX NO:
EMAIL ADDRESS:

CONTRACTOR INFORMATION (provide this information if a Contractor is working on behalf of the Proponent)

NAME:
STREET ADDRESS:
CITY/TOWN:
PROVINCE/TERRITORY:
POSTAL CODE:
TEL. NO. (RESIDENCE):
TEL. NO. (WORK):
FAX NO:
EMAIL ADDRESS:

PROJECT INFORMATION

Select Operational Statements that are being used (check all applicable boxes):

- ❒ Beaver Dam Removal
- ❒ Bridge Maintenance
- ❒ Clear-Span Bridges
- ❒ Culvert Maintenance
- ❒ High-Pressure Directional Drilling
- ❒ Ice Bridges and Snow Fills
- ❒ Isolated Pond Construction
- ❒ Isolated or Dry Open-cut Stream Crossings
- ❒ Maintenance of Riparian Vegetation in Existing Rights-of-Way
- ❒ Moorings
- ❒ Overhead Line Construction
- ❒ Punch & Bore Crossings
- ❒ Routine Maintenance Dredging
- ❒ Submerged Log Salvage
- ❒ Temporary Stream Crossing
- ❒ Underwater Cables

Select the type of water body or watercourse at or near your project:

- ❒ River, Stream, Creek
- ❒ Lake (3 hectares or greater)
- ❒ Pond or wetland (pond is less than a hectare)

PROJECT LOCATION (If Start Date or Location of Site changed from Proposed Authorization, approval cannot be used. Contact DFO for a new Notification Form.)

Name of water body or watercourse	Coordinates of the Project (UTM co-ordinates or Degrees, Minutes, Seconds), if available Easting: Northing: Latitude: Longitude:
Legal Description (LSD, Quarter, Section, Township, Range, Meridian)	Directions to Access the Project Site (i.e., Route or highway number, etc.)
Proposed Start Date (YYYY/MM/DD):	Proposed Completion Date (YYYY/MM/DD)

We ask that you notify DFO, preferably 14 working days before starting your work, by filling out and sending in, by mail or by fax, this notification form to the DFO office in your area. This information is requested in order to evaluate the effectiveness of the work carried out in relation to the Operational Statement.

I, _____ (print name) certify that the information given on this form is, to the best of my knowledge, correct and complete.

Signature _____ Date _____

Note: If you cannot meet all of the conditions and cannot incorporate all of the measures in the Operational Statement then your project may result in a violation of subsection 35(1) of the Fisheries Act and you could be subject to enforcement action. In this case, you should contact the DFO office in your area if you want to obtain DFO's opinion on the possible options you should consider to avoid contravention of the Fisheries Act.

Information about the above-noted proposed work or undertaking is collected by DFO under the authority of the Fisheries Act for the purpose of administering the fish habitat protection provisions of the Fisheries Act. Personal information will be protected under the provisions of the Privacy Act and will be stored in the Personal Information Bank DFO SOI 455. Under the Privacy Act, individuals have a right to, and an request shall be given access to, any personal information about them contained in a personal information bank. Instructions for obtaining particular information are contained in the Government of Canada Info Source publications available at www.tbs-sct.gc.ca or in Government of Canada offices. Information other than "personal" information may be accessible or protected as required by the provisions of the Access to Information Act.

Canada

Source:
http://www.dfo-mpo.gc.ca/regions/central/habitat/os-eo/provinces-territories-territoires/ab/pdf/os-eo20_e.pdf (accessed January 28 2011)

APPENDIX 2: HIGH-PRESSURE DIRECTIONAL DRILLING OPERATIONAL STATEMENT FOR ALBERTA

Fisheries and Oceans Canada | Pêches et Océans Canada

HIGH-PRESSURE DIRECTIONAL DRILLING

Fisheries and Oceans Canada
Alberta Operational Statement

Version 3.0

For the purpose of this Operational Statement, the term High-Pressure Directional Drilling (HPDD) means trenchless methods of crossing a watercourse using pressurized mud systems. HPDD is used to install cables and pipelines for gas, telecommunications, fibre optics, power, sewer, oil and water lines underneath watercourses and roads. This method is preferable to open-cut and isolated crossings since the cable or pipeline is drilled underneath the watercourse with very little disturbance to the bed or banks. HPDD involves drilling a pilot bore hole underneath the watercourse towards a surface target, back-reaming the bore hole to the drill rig while pulling the pipe along through the hole. This process typically uses the freshwater gel mud system composed of a mixture of clean, freshwater as the base, bentonite (clay-based drilling lubricant) as the viscosifier and synthetic polymers.

The general order of preference for carrying out a cable or pipeline stream crossing in order to protect fish and fish habitat is: a) a punch or bore crossing (see *Punch & Bore Crossings* Operational Statement), b) HPDD crossing, c) dry open-cut crossing, and d) isolated open-cut crossing (see *Isolated or Dry Open-cut Stream Crossings* Operational Statement). This order must be balanced with practical considerations at the site.

One of the risks associated with HPDD is the escape of drilling mud into the environment as a result of a spill, tunnel collapse or the rupture of mud to the surface, commonly known as "frac-out". A frac-out is caused when excessive drilling pressure results in drilling mud propagating toward the surface. The risk of a frac-out can be reduced through proper geotechnical assessment practices and drill planning and execution. The extent of a frac-out can be limited by careful monitoring and having appropriate equipment and response plans ready in the event that one occurs. HPDD can also result in excessive disturbance of riparian vegetation and sedimentation and erosion due to operation of equipment on the shoreline or fording to access the opposite bank.

Fisheries and Oceans Canada (DFO) is responsible for protecting fish and fish habitat across Canada. Under the *Fisheries Act* no one may carry out a work or undertaking that will cause the harmful alteration, disruption or destruction (HADD) of fish habitat unless it has been authorized by DFO. By following the conditions and measures set out below you will be in compliance with subsection 35(1) of the *Fisheries Act*.

The purpose of this Operational Statement is to describe the conditions under which it is applicable to your project and the measures to incorporate into your project in order to avoid negative impacts to fish habitat. You may proceed with your high-pressure directional drill project without a DFO review when you meet the following conditions:

- the project is not located on a Class A stream according to the *Alberta Water Act – Code of Practice*,
- the crossing technique will not damage the aquatic environment and thereby negatively impact fish or fish habitat,
- the site does not occur at a stream location involving known fish spawning habitat, particularly if it is dependent on groundwater upwelling,
- the crossing is not a wet open-cut crossing,
- you have an emergency frac-out response plan and a contingency crossing plan in place that outline the protocol to monitor, contain and clean-up a potential frac-out and an alternative method for carrying out the crossing, and
- you incorporate the *Measures to Protect Fish and Fish Habitat when High-Pressure Directional Drilling* listed below in this Operational Statement.

If you cannot meet all of the conditions listed above and cannot incorporate all of the measures listed below then your project may result in a violation of subsection 35(1) of the *Fisheries Act* and you could be subject to enforcement action. In this case, you should contact the DFO office in your area if you wish to obtain DFO's opinion on the possible options you should consider to avoid contravention of the *Fisheries Act*.

You are required to respect all municipal, provincial or federal legislation that applies to the work being carried out in relation to this Operational Statement. The activities undertaken in this Operational Statement must also comply with the *Species at Risk Act* (**www.sararegistry.gc.ca**). If you have questions regarding this Operational Statement, please contact the DFO office in your area (see Alberta DFO office list).

We ask that you notify DFO, preferably 14 days before starting your work by filling out and sending the Alberta Operational Statement notification form (**www.dfo-mpo.gc.ca/regions/central/habitat/os-eo/prov-terr/index_e.htm**) to the DFO office in your area. This information is requested in order to evaluate the effectiveness of the work carried out in relation to this Operational Statement.

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APPENDIX 2 (CONT'D): HIGH-PRESSURE DIRECTIONAL DRILLING OPERATIONAL STATEMENT FOR ALBERTA

Measures to Protect Fish and Fish Habitat when High-Pressure Directional Drilling

1. Use existing trails, roads or cut lines wherever possible, as access routes to avoid disturbance to the riparian vegetation.

2. Design the drill path to an appropriate depth below the watercourse to minimize the risk of frac-out and to a depth to prevent the line from becoming exposed due to natural scouring of the stream bed. The drill entry and exit points are far enough from the banks of the watercourse to have minimal impact on these areas.

3. While this Operational Statement does not cover the clearing of riparian vegetation, the removal of select plants may be necessary to access the construction site. This removal should be kept to a minimum and within the road or utility right-of-way way or approved work space.

4. Machinery fording the watercourse to bring equipment required for construction to the opposite side is limited to a one-time event (over and back) and should occur only if an existing crossing at another location is not available or practical to use. A *Temporary Stream Crossing* Operational Statement is also available.

   4.1. If minor rutting is likely to occur, stream bank and bed protection methods (e.g., swamp mats, pads) should be used provided they do not constrict flows or block fish passage.
   4.2. Grading of the stream banks for the approaches should not occur.
   4.3. If the stream bed and banks are steep and highly erodible (e.g., dominated by organic materials and silts) and erosion and degradation are likely to occur as a result of equipment fording, then a temporary crossing structure or other practice should be used to protect these areas.
   4.4. Time the one-time fording to prevent disruption to sensitive fish life stages by adhering to appropriate fisheries timing windows (see *Alberta Water Act - Code of Practice* restricted activity periods, which can be found at: **http://www3.gov.ab.ca/env/water/legislation/cop/mapindex.html**).
   4.5. Fording should occur under low flow conditions and not when flows are elevated due to local rain events or seasonal flooding.

5. Operate machinery on land above the ordinary high water mark (see definition below) and in a manner that minimizes disturbance to the banks of the watercourse.

   5.1. Machinery is to arrive on site in a clean condition and is to be maintained free of fluid leaks.
   5.2. Wash, refuel and service machinery and store fuel and other materials for the machinery away from the water to prevent any deleterious substance from entering the water.
   5.3. Keep an emergency spill kit on site in case of fluid leaks or spills from machinery.
   5.4. Restore banks to original condition if any disturbance occurs.

6. Construct a dugout/settling basin at the drilling exit site to contain drilling mud to prevent sediment and other deleterious substances from entering the watercourse. If this cannot be achieved, use silt fences or other effective sediment and erosion control measures to prevent drilling mud from entering the watercourse. Inspect these measures regularly during the course of construction and make all necessary repairs if any damage occurs.

   6.1. Dispose of excess drilling mud, cuttings and other waste materials at an adequately sized disposal facility located away from the water to prevent it from entering the watercourse.

7. Monitor the watercourse to observe signs of surface migration (frac-out) of drilling mud during all phases of construction.

Emergency Frac-out Response and Contingency Planning

8. Keep all material and equipment needed to contain and clean up drilling mud releases on site and readily accessible in the event of a frac-out.

9. Implement the frac-out response plan that includes measures to stop work, contain the drilling mud and prevent its further migration into the watercourse and notify all applicable authorities, including the Alberta Environment Hotline at 1-800-222-6514, and the closest DFO office in the area (see Alberta DFO office list). Prioritize clean up activities relative to the risk of potential harm and dispose of the drilling mud in a manner that prevents re-entry into the watercourse.

10. Ensure clean up measures do not result in greater damage to the banks and watercourse than from leaving the drilling mud in place.

11. Implement the contingency crossing plan including measures to either re-drill at a more appropriate location or to isolate the watercourse to complete the crossing at the current location. See *Isolated or Dry Open-cut Stream Crossings* Operational Statement for carrying out an isolated trenched crossing.

12. Stabilize any waste materials removed from the work site to prevent them from entering the watercourse. This could include covering spoil piles with biodegradable mats or tarps or planting them with preferably native grass or shrubs.

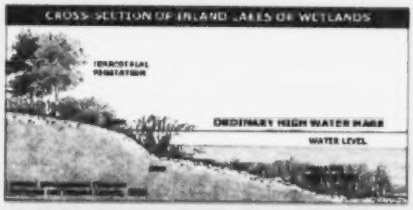
13. Vegetate any disturbed areas by planting and seeding preferably with native trees, shrubs or grasses and cover such areas with mulch to prevent erosion and to help seeds germinate. If there is insufficient time remaining in the growing season, the site should be stabilized (e.g., cover exposed areas with erosion control blankets to keep the soil in place and prevent erosion) and vegetated the following spring.

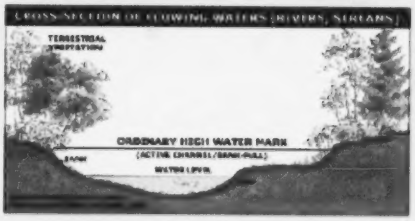
   13.1. Maintain effective sediment and erosion control measures until re-vegetation of disturbed areas is achieved.

APPENDIX 2 (CONT'D): HIGH-PRESSURE DIRECTIONAL DRILLING OPERATIONAL STATEMENT FOR ALBERTA

Definition:

Ordinary high water mark – The usual or average level to which a body of water rises at its highest point and remains for sufficient time so as to change the characteristics of the land. In flowing waters (rivers, streams) this refers to the "active channel/ bank-full level" which is often the 1:2 year flood flow return level. In inland lakes or wetlands, it refers to those parts of the water body bed and banks that are frequently flooded by water so as to leave a mark on the land and where the natural vegetation changes from predominately aquatic vegetation to terrestrial vegetation (excepting water tolerant species). For reservoirs this refers to normal high operating levels (Full Supply Level).





FISHERIES AND OCEANS CANADA OFFICES IN ALBERTA

Calgary Office
Fisheries and Oceans Canada
7646-8th St. NE
Calgary, Alberta, T2E 8X4
General Inquiries: 403-292-5160
Fax: 403-292-5173
Email: Referrals.Calgary@dfo-mpo.gc.ca

Edmonton Office
Fisheries and Oceans Canada
Whitemud Business Park
4253-97th Street
Edmonton, Alberta, T6E 5Y7
General Inquiries: 780-495-4220
Fax: 780-495-8606
Email: Referrals.Edmonton@dfo-mpo.gc.ca

Lethbridge Office
Fisheries and Oceans Canada
J.D. Higinbotham Building
204, 704-4 Avenue South
Lethbridge, Alberta, T1J 0N8
General Inquiries: 403-394-2920
Fax: 403-394-2917
Email: Referrals.Lethbridge@dfo-mpo.gc.ca

Peace River Office
Fisheries and Oceans Canada
9001-94th Street
Peace River, Alberta, T8S 1G9
General Inquiries: 780-618-3220
Fax: 780-618-3235
Email: Referrals.PeaceRiver@dfo-mpo.gc.ca

Aussi disponible en français

http://www.dfo-mpo.gc.ca/oceans-habitat/habitat/modernizing-moderniser/epmp-pmpe/index_f.asp

DFO/2007-1329

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This Operational Statement Version 2.1 shall be updated as required by Fisheries and Oceans Canada. It is your responsibility to use the most recent version. Please refer to the Operational Statements web site at http://www.dfo-mpo.gc.ca/oceans-habitat/habitat/modernizing-moderniser/epmp-pmpe/index_e.asp to ensure that a more recent version has not been released.

Source:
http://www.dfo-mpo.gc.ca/regions/central/habitat/os-eo/provinces-territories-territoires/ab/pdf/os-eo09_e.pdf (accessed January 28 2011)

APPENDIX 3: PUNCH & BORE CROSSINGS OPERATIONAL STATEMENT FOR ALBERTA

Fisheries and Oceans Canada | Pêches et Océans Canada

PUNCH & BORE CROSSINGS

Fisheries and Oceans Canada
Alberta Operational Statement

Version 3.0

For the purpose of this Operational Statement, the term punch and bore refers to a trenchless crossing method which involves the excavation of a vertical bell hole or shallow depression on either side of the watercourse. Horizontal punching or boring between the two points, at an appropriate depth below the watercourse, completes the creation of a passage-way for the crossing. Punch and bore crossings allow cables and pipelines to be installed under watercourses without imparting any disturbance to the bed and banks. Punch and bore crossings differ from high-pressure directional drilled crossings, in that no pressurized mud systems are required, thereby avoiding the risk of sediment release due to frac-out.

Punch and bore crossings can negatively impact fish and fish habitat due to erosion and sedimentation from site disturbance and dewatering of bell holes or the collapse of the punch or bore hole under the stream. Disturbing riparian vegetation can reduce important shoreline cover, shade and food production areas. Machinery fording the stream can disturb bottom and bank substrates, disrupt sensitive fish life stages, and introduce deleterious substances if equipment is not properly maintained. Impacts can be reduced if an emergency response plan and clean-up materials are in place.

The general order of preference for carrying out a cable or pipeline stream crossing in order to protect fish and fish habitat is: a) a punch or bore crossing, b) high-pressure directional drill crossing (see *High-Pressure Directional Drilling* Operational Statement), c) dry open-cut crossing, and d) isolated open-cut crossing (see *Isolated or Dry Open-cut Stream Crossings* Operational Statement). This order must be balanced with practical considerations at the site.

Fisheries and Oceans Canada (DFO) is responsible for protecting fish and fish habitat across Canada. Under the *Fisheries Act* no one may carry out a work or undertaking that will cause the harmful alteration, disruption or destruction (HADD) of fish habitat unless it has been authorized by DFO. By following the conditions and measures set out below you will be in compliance with subsection 35(1) of the *Fisheries Act*.

The purpose of this Operational Statement is to describe the conditions under which it is applicable to your project and the measures to be incorporated into your project in order to avoid negative impacts to fish habitat. You may proceed with your punch or bore crossing project without a DFO review when you meet the following conditions:

- the project is not located on a Class A stream according to the *Alberta Water Act – Code of Practice*,
- the crossing is not a wet open-cut crossing,
- the crossing technique will not damage the aquatic environment and thereby negatively impact fish or fish habitat,
- the site does not occur at a stream location involving known fish spawning habitat, particularly if it is dependent on groundwater upwelling, and
- you incorporate the *Measures to Protect Fish and Fish Habitat when Conducting Punch and Bore Crossings*, listed below.

If you cannot meet all of the conditions listed above and cannot incorporate all of the measures listed below then your project may result in a violation of subsection 35(1) of the *Fisheries Act* and you could be subject to enforcement action. In this case, you should contact the DFO office in your area if you wish to obtain DFO's opinion on the possible options you should consider to avoid contravention of the *Fisheries Act*.

You are required to respect all municipal, provincial or federal legislation that applies to the work being carried out in relation to this Operational Statement. The activities undertaken in this Operational Statement must also comply with the *Species at Risk Act* (**www.sararegistry.gc.ca**). If you have questions regarding this Operational Statement, please contact the DFO office in your area (see Alberta DFO office list).

We ask that you notify DFO, preferably 14 days before starting your work by filling out and sending the Alberta Operational Statement notification form (**www.dfo-mpo.gc.ca/regions/central/habitat/os-eo/prov-terr/index_e.htm**) to the DFO office in your area. This information is requested in order to evaluate the effectiveness of the work carried out in relation to this Operational Statement.

Measures to Protect Fish and Fish Habitat when Conducting Punch and Bore Crossings

1. A punch or bore crossing can be conducted at any time of the year provided there is not a high risk of failure and it does not require in-water activities such as machinery fording.
2. Design the punch or bore path for an appropriate depth below the watercourse to prevent the pipeline or cable from becoming exposed due to natural scouring of the stream bed.
3. While this Operational Statement does not cover the clearing of riparian vegetation, the removal of select plants may be necessary to access the construction site and to excavate the bell holes. This removal is to be kept to a minimum and within the utility right-of-way or approved work space.
4. Install effective sediment and erosion control measures before starting work to prevent entry of sediment into the water body.

Canada

Inspect them regularly during the course of construction and make all necessary repairs if any damage occurs.

5. Machinery fording the watercourse to bring equipment required for construction to the opposite side is limited to a one-time event (over and back) and should occur only if an existing crossing at another location is not available or practical to use. A *Temporary Stream Crossing* Operational Statement is also available.

   5.1. If minor rutting is likely to occur, stream bank and bed protection methods (e.g., swamp mats, pads) should be used provided they do not constrict flows or block fish passage.
   5.2. Grading of the stream banks for the approaches should not occur.
   5.3. If the stream bed and banks are steep and highly erodible (e.g., dominated by organic materials and silts) and erosion and degradation are likely to occur as a result of equipment fording, then a temporary crossing structure or other practice should be used to protect these areas.
   5.4. Time the one-time fording to prevent disruption to sensitive fish life stages by adhering to appropriate fisheries timing windows (see *Alberta Water Act - Code of Practice* restricted activity periods, which can be found at: **http://www3.gov.ab.ca/env/water/legislation/cop/mapindex.html**).
   5.5. Fording should occur under low flow conditions and not when flows are elevated due to local rain events or seasonal flooding.

6. Operate machinery on land above the ordinary high water mark (HWM) (see definition below) and in a manner that minimizes disturbance to the banks of the watercourse.

   6.1. Machinery is to arrive on-site in a clean condition and is to be maintained free of fluid leaks.
   6.2. Wash, refuel and service machinery and store fuel and other materials for the machinery away from the water to prevent any deleterious substance from entering the water.
   6.3. Keep an emergency spill kit on site in case of fluid leaks or spills from machinery.

7. Excavate bell holes beyond the HWM, far enough away from any watercourse to allow containment of any sediment or deleterious substances above the HWM.

   7.1. When dewatering bell holes, remove suspended solids by diverting water into a vegetated area or settling basin, and prevent sediment and other deleterious substances from entering the watercourse.
   7.2. Stabilize any waste materials removed from the work site (including bell holes) to prevent them from entering the watercourse. This could include covering spoil piles with biodegradable mats or tarps or planting them with grass or shrubs.
   7.3. After suitably backfilling and packing the bell holes, vegetate any disturbed areas (see Measure 11).

8. Monitor the watercourse to observe signs of malfunction during all phases of the work.

9. For the duration of the work, keep on-site and readily accessible, all material and equipment needed to contain and clean-up releases of sediment-laden water and other deleterious substances.

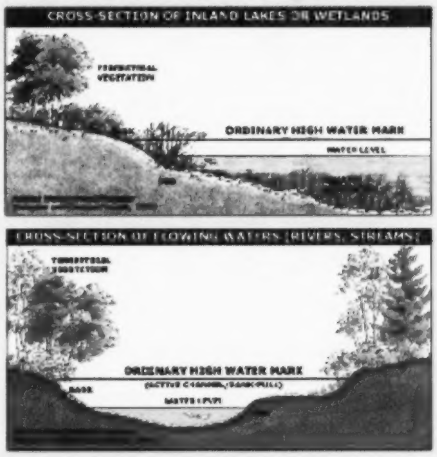
10. Develop a response plan that is to be implemented immediately in the event of a sediment release or spill of a deleterious substance. This plan is to include measures to: a) stop work, contain sediment-laden water and other deleterious substances and prevent their further migration into the watercourse; b) notify all applicable authorities in the area, including the Alberta Environment Hotline at 1-800-222-6514, and the closest DFO office; c) promptly clean-up and appropriately dispose of the sediment-laden water and deleterious substances; and d) ensure clean-up measures are suitably applied so as not to result in further alteration of the bed and/or banks of the watercourse.

11. Vegetate any disturbed areas by planting and seeding preferably with native trees, shrubs or grasses and cover such areas with mulch to prevent erosion and to help seeds germinate. If there is insufficient time remaining in the growing season, the site should be stabilized (e.g., cover exposed areas with erosion control blankets to keep the soil in place and prevent erosion) and vegetated the following spring.

    11.1. Maintain effective sediment and erosion control measures until re-vegetation of disturbed areas is achieved.

Definition:

Ordinary high water mark (HWM) – The usual or average level to which a body of water rises at its highest point and remains for sufficient time so as to change the characteristics of the land. In flowing waters (rivers, streams) this refers to the "active channel/ bank-full level" which is often the 1:2 year flood flow return level. In inland lakes or wetlands, it refers to those parts of the water body bed and banks that are frequently flooded by water so as to leave a mark on the land and where the natural vegetation changes from predominately aquatic vegetation to terrestrial vegetation (excepting water tolerant species). For reservoirs this refers to normal high operating levels (Full Supply Level).


CROSS-SECTION OF INLAND LAKES OR WETLANDS
ORDINARY HIGH WATER MARK
CROSS-SECTION OF FLOWING WATERS (RIVERS, STREAMS)
ORDINARY HIGH WATER MARK

APPENDIX 3 (CONT'D): PUNCH & BORE CROSSINGS OPERATIONAL STATEMENT FOR ALBERTA

FISHERIES AND OCEANS CANADA OFFICES IN ALBERTA

Calgary Office
Fisheries and Oceans Canada
7646-8th St. NE
Calgary, Alberta, T2E 8X4
General Inquiries: 403-292-5160
Fax: 403-292-5173
Email: ReferralsCalgary@dfo-mpo.gc.ca

Edmonton Office
Fisheries and Oceans Canada
Whitemud Business Park
4253-97th Street
Edmonton, Alberta, T6E 5Y7
General Inquiries: 780-495-4220
Fax: 780-495-8606
Email: ReferralsEdmonton@dfo-mpo.gc.ca

Lethbridge Office
Fisheries and Oceans Canada
J.D. Higinbotham Building
204, 704-4th Avenue South
Lethbridge, Alberta, T1J 0N8
General Inquiries: 403-394-2920
Fax: 403-394-2917
Email: ReferralsLethbridge@dfo-mpo.gc.ca

Peace River Office
Fisheries and Oceans Canada
9001-94th Street
Peace River, Alberta, T8S 1G9
General Inquiries: 780-618-3220
Fax: 780-618-3235
Email: ReferralsPeaceRiver@dfo-mpo.gc.ca

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DFO/2007-1329

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This Operational Statement Version 1.0 may be updated or replaced by Fisheries and Oceans Canada. It is your responsibility to use the most recent version. Please refer to the Operational Statements web site at http://www.dfo-mpo.gc.ca/oceans-habitat/habitat/modernizing-moderniser/epmp-pmpe/index_e.asp to make sure that a more recent version has not been released.

Source:
http://www.dfo-mpo.gc.ca/regions/central/habitat/os-eo/provinces-territories-territoires/ab/pdf/os-eo16_e.pdf (accessed January 28 2011

APPENDIX 4: HABITAT MANAGEMENT PROGRAM TRENCHLESS CROSSING MONITORING FORMS

Punch and Bore Crossing Monitoring Form for Aquatic SAR Project 2010

Fisheries and Oceans Canada | Pêches et Océans Canada

Central & Arctic Region
Operational Statements – Habitat Management Program

Section A

Location Details

DFO Project Title (*if applicable*):	PATH File Number:
Name of Watercourse (*e.g. Stream, River, Lake, Bay*):	
Name of nearest community to the activity (*e.g., City, Town, Village*):	Latitude and Longitude (dd,mm,ss): N: E: UTM: ZONE (11 OR 12):
Municipality/District/County:	Legal Description (*e.g. Lot, Concession, Township, Section, Range*):

Site Visit Information

Monitoring Date: Weather Conditions (*e.g., Temperature, Sunny, Precipitation, etc.*): Proposed start/completion date:	Status of Project: □ Work is on-going during the site visit □ Work is completed Date Completed: _____

Section B

Questions Related to Potential Impact to Fish Habitat

Did the activity have an impact to fish habitat? *(Note: this section to be filled out for every site visit)*

Questions	Yes	No	If Yes: Estimate the Area Impacted (m^2)
Is there evidence of active erosion or sedimentation?	□	□	
Are the banks stable and intact -is there evidence of slumping or sedimentation?	□	□	
Are macrophytes stable and intact - is there evidence of disturbance or recent die off?	□	□	
Is there any evidence of infilling?	□	□	
Is there any evidence of channel realignment?	□	□	

Provide any additional details/ observations/ comments including the rationale for checking off 'Yes'. (Was fish habitat impacted?):

NOTE: for photos please use unique identifier number

APPENDIX 4 (CONT'D): PUNCH AND BORE MONITORING FORM

Section C

Conformity with Conditions of Operational Statements

Did the proponent meet the specified conditions in the Operational Statement?
(***Note***: Based on the timing of the site visit, it may be difficult to determine if all the conditions were met – in these cases check off 'Unknown'); *N/A= not applicable

Conditions in Operational Statement	**Compliance with Conditions**	**Not in Compliance**	**Unknown**	***N/A**
The crossing was not a wet open-cut crossing.	☐	☐	☐	☐
The site did not occur at a stream location involving known fish spawning habitat, particularly if it is dependent on groundwater up-welling.	☐	☐	☐	☐
The technique did not damage the aquatic environment and thereby negatively impact fish or fish habitat.	☐	☐	☐	☐
Conditions to Monitor During Construction (only to be completed if you are on-site during construction)	**Compliance with Conditions**	**Not in Compliance**	**Unknown**	***N/A**
The punch and bore crossing technique did not damage the streambed or bank and did not negatively impact fish or fish habitat.	☐	☐	☐	☐

Provide any additional details/ observations/ comments including the rationale for checking off 'Not in Compliance' or 'Unknown'. (Were these conditions effective in protecting fish habitat and, if not, explain.)

Region-Specific Conditions	**Compliance with Conditions**	**Not in Compliance**	**Unknown**	***N/A**
Alberta: The project was not located on a Class A stream according to the *Alberta Water Act – Code of Practice*.	☐	☐	☐	☐

APPENDIX 4 (CONT'D): PUNCH AND BORE MONITORING FORM

SectionD

Conformity with Measures to Protect Fish and Fish Habitat

Did the proponent meet the specified measures in the Operational Statement?
(*Note*: Based on the timing of the site visit, it may be difficult to determine if all the conditions were met – in these cases check off 'Unknown'); *N/A= not applicable

Measures to Protect Fish Habitat	**Compliance with Measures**	**Not in Compliance**	**Unknown**	***N/A**
The punch and bore path was designed for an appropriate depth to prevent the pipeline or cable from being exposed due to natural streambed scouring processes.	☐	☐	☐	☐
Following the backfilling and packing of bell holes, disturbed areas were re-vegetated with native trees, shrubs, or grasses and/or stabilized at project completion.	☐	☐	☐	☐
Measures to Monitor During Construction (only to be completed if you are on-site during construction)	**Compliance with Measures**	**Not in Compliance**	**Unknown**	***N/A**
One-time fording adhered to provincial fisheries timing windows whenever activities had the potential to disrupt sensitive fish life stages.	☐	☐	☐	☐
Emergency material and equipment was readily accessible to contain and clean-up any release of sediment-laden water or deleterious substances.	☐	☐	☐	☐
An emergency response plan was active, clearly understood by all workers on-site, and included measure to contain the spill or release of sediment, the contact name and number for the closest DFO office, and clean-up measures which will not result in further alteration of the bed and/or banks of the watercourse.	☐	☐	☐	☐
Sediment and Erosion Control Mitigation				
Erosion and sediment control measures were installed, effective, and in good repair and remained in place until re-vegetation of disturbed areas was achieved.	☐	☐	☐	☐
The watercourse was monitored to observe signs of malfunction during all phases of the work.	☐	☐	☐	☐

Section D

Conformity with Measures to Protect Fish and Fish Habitat (continued)

Did the proponent meet the specified measures in the Operational Statement?
(*Note*: Based on the timing of the site visit, it may be difficult to determine if all the conditions were met – in these cases check off 'Unknown'); *N/A= not applicable

Measures to Monitor During Construction (only to be completed if you are on-site during construction)	**Compliance with Measures**	**Not in Compliance**	**Unknown**	***N/A**
Site Stabilization Mitigation				
Removal of riparian vegetation was kept to a minimum and was kept within the road or utility right-of-way.	☐	☐	☐	☐
Machinery was operated on land above the ordinary high water mark in a manner that minimized disturbance to the banks of the watercourse.	☐	☐	☐	☐
There was no grading of the stream banks for the approaches.	☐	☐	☐	☐
Fording to bring construction equipment to the opposite side was a one-time event (over and back) and only occurred because an existing crossing was not available or practical to use. Fording did not occur during elevated flows.	☐	☐	☐	☐
Where minor rutting was likely to occur, stream bank and be protection methods (e.g., swamp mats, pads) were used and did not constrict flows or block fish passage.	☐	☐	☐	☐
Damage to steep and highly erodible stream banks and beds by equipment fording was avoided through use of a temporary crossing structure or other method.	☐	☐	☐	☐
All waste materials removed from site (including bell holes) were adequately stabilized to prevent escape into the watercourse.	☐	☐	☐	☐
Deleterious Substances Mitigation				
Machinery arrived on-site clean and free of fluid leaks.	☐	☐	☐	☐
Fuel and machinery materials were stored away from the water to prevent the escape of deleterious substances into the water. Machinery was serviced, washed, and re-fuelled away from the water.	☐	☐	☐	☐
Contractor had an emergency spill kit on-site.	☐	☐	☐	☐
Bell hole excavation occurred above the ordinary high water mark so that sediment and deleterious substances could be contained to prevent escape into the watercourse.	☐	☐	☐	☐
Water from dewatering the bell holes was diverted into vegetated areas or settling basins to remove suspended solids and prevent the escape of sediment and deleterious materials into the watercourse.	☐	☐	☐	☐

APPENDIX 4 (CONT'D): PUNCH AND BORE MONITORING FORM

Species at Risk (SAR) Considerations and Conditions:

Provide any additional details/ observations/ comments including the rationale for checking off 'Yes'. (Was fish habitat impacted?):

Is there a compliance issue with the *Species at Risk Act*? □ Yes □ No

Did the crossing occur on potential aquatic SAR Critical Habitat? **Yes No or Unknown** (Please Circle)

Other notes on Species at Risk areas including evidence of species presence, anything unique about the area, or issues/situations encountered not covered by this monitoring form.

APPENDIX 4 (CONT'D): PUNCH AND BORE MONITORING FORM

Section E

Effectiveness of Operational Statement

Did work carried out under this Operational Statements result in any negative impacts to fish and fish habitat?

☐ Yes ☐ No

If yes, why did the negative impact occur (check off all appropriate boxes)?

- ☐ Conditions were not followed and the project was outside of the scope of the Operational Statement
- ☐ Conditions were not adequate to protect fish habitat (Provide details below of what measures need to be added and why)
- ☐ Measures were not followed
- ☐ Measures were not adequate (Provide details below of what measures need to be added and why)
- ☐ Habitat Sensitivity (Provide details below)
- ☐ Other (e.g., extreme weather conditions)
- ☐ Unknown

Detail how these impacts may have been averted and provide recommendations for improvement.

APPENDIX 4 (CONT'D): PUNCH AND BORE MONITORING FORM

For Fisheries and Oceans Canada Office Use only:

Monitoring Site Visit Completed by: _____

Others who attended site visit: _____

DFO Habitat File # (if applicable): _____ **Office:** _____

Proponent Notification Form (NF) Received □ **Yes** □ **No** **Date NF Received:** _____

Photos Taken: □ **Yes** □ **No** **Note:** Digital photos can be saved on the PATH Picture *screen*

Photo ID Number(s) and storage location _____

GPS Coordinates for Site Location (UTM) _____

Recommendations/Evaluation of Effectiveness of Operational Statement based on site visit observations:

_____

_____

_____

1. Were the Conditions in the OS met? ☐ **Yes** ☐ **No** ☐ **Partial** ☐ **Unknown**

(If not, was habitat impacted negatively (describe in notes on PATH screen)

2. Were the mitigation measures provided conformed with?
☐ **Yes** ☐ **No** ☐ **Partial** ☐ **Unknown**

(If not, was habitat impacted negatively (describe in notes on PATH screen)

3. Were the mitigation measures effective in preventing negative impacts to fish habitat?
☐ **Yes** ☐ **No** ☐ **Partial** ☐ **Unknown**

4. Are there remedial measures or additional mitigation measures required?
☐ **Yes** ☐ **No** ☐ **Unknown**

5. If required were remedial measures or mitigation measures implemented and/or conformed with?
☐ **Yes** ☐ **No** ☐ **Partial** ☐ **Unknown**

Common Questions:

1. Is there a compliance issue with the *Fisheries Act*? □ **Yes** □ **No**

2. If there is a compliance issue with the Fisheries Act, will there be further compliance action required? □ **Yes** □ **No**

3. Is Habitat Monitoring now complete on this action? □ **Yes** □ **No**

High Pressure Directional Drilling Monitoring Form - Aquatic SAR Project 2010

Fisheries and Oceans Canada | Pêches et Océans Canada

Section A

Location Details

DFO Project Title (*if applicable*):	PATH File Number:
Name of Watercourse (*e.g. Stream, River, Lake, Bay*):	
Name of nearest community to the activity (*e.g., City, Town, Village*):	Latitude and Longitude (dd,mm,ss): N: E: **UTM:** **Zone (11 or 12):**
Municipality/District/County:	Legal Description (*e.g. Lot, Concession, Township, Section, Range*):

Site Visit Information

Monitoring Date: Weather Conditions (*e.g., Temperature, Sunny, Precipitation, etc.*): Proposed start/completion date:	Status of Project: □ Work is on-going during site visit □ Work is completed Date Completed: _____

Section B

Questions Related To Potential Impact To Fish Habitat

Did the activity have an impact to fish habitat? *(Note: this section to be filled out for every site visit)*

Questions	Yes	No	If Yes: Estimate the Area Impacted (m^2)
Is there evidence of active erosion or sedimentation?	□	□	
Are the banks stable and intact - is there evidence of slumping or sedimentation?	□	□	
Is there evidence of a frac-out?	□	□	
Has there been excessive damage to riparian vegetation?	□	□	
Are macrophytes stable and intact - is there evidence of recent die off?	□	□	

Provide any additional details/ observations/ comments including the rationale for checking off 'Yes'. Please include any other issues relating to impacts on fish and fish habitat: Note: please use unique identifier number for photos.

Section C

Conformity with Conditions of Operational Statement

Did the proponent meet the specified conditions in the Operational Statement?
(***Note***: Based on the timing of the site visit, it may be difficult to determine if all the conditions were met – in these cases check off 'Unknown'); *N/A= not applicable

Conditions in Operational Statement to be Monitored During Construction (only to be completed if you are on-site during construction)	**Compliance with Conditions**	**Not in Compliance**	**Unknown**	***N/A**
The crossing technique did not damage the streambed and did not negatively impact fish habitat.	☐	☐	☐	☐
The crossing was not a wet open-cut crossing.	☐	☐	☐	☐
A frac-out emergency plan and contingency crossing plan was in place prior to construction.	☐	☐	☐	☐

Provide any additional details/ observations/ comments including the rationale for checking off 'Not in Compliance' or 'Unknown'. Please include any other issues relating to impacts on fish and fish habitat: Note: please use unique identifier number for photos.

Region-Specific Conditions	**Compliance with Conditions**	**Not in Compliance**	**Unknown**	***N/A**
Alberta: The project was not located on a Class A stream according to the *Alberta Water Act – Code of Practice*.	☐	☐	☐	☐

Section D

Conformity with Measures to Protect Fish and Fish Habitat

Did the proponent meet the specified measures in the Operational Statement?
(***Note***: Based on the timing of the site visit, it may be difficult to determine if all the conditions were met – in these cases check off 'Unknown'); *N/A= not applicable

Measures to Protect Fish Habitat	**Compliance with Conditions**	**Not in Compliance**	**Unknown**	***N/A**
Banks were restored to their original condition if any disturbance occurred.	☐	☐	☐	☐
Disturbed areas were re-vegetated with native trees, shrubs, or grasses and/or stabilized at project completion.	☐	☐	☐	☐
Measures to Monitor During Construction (only to be completed if you are on-site during construction)	**Compliance with Conditions**	**Not in Compliance**	**Unknown**	***N/A**
One-time fording to bring construction equipment required for construction to the opposite side adhered to provincial fisheries timing windows whenever activities had the potential to disrupt sensitive fish life stages.	☐	☐	☐	☐
Drill depth was determined prior to construction to minimize the risk of frac-out or exposure of the pipeline or cable. Drill entry and exit points were far enough from the banks of the watercourse to have minimal impact on these areas.	☐	☐	☐	☐
<u>Sediment and Erosion Control Mitigation</u>				
The watercourse was closely monitored for signs of surface migration (frac-out) of drilling mud during all phases of construction.	☐	☐	☐	☐
Sediment and erosion control measures were maintained until re-vegetation of disturbed areas was achieved.	☐	☐	☐	☐
<u>Site Stabilization Mitigation</u>				
Existing trails, roads, or cut lines were used wherever possible to avoid disturbance to riparian vegetation.	☐	☐	☐	☐
Removal of riparian vegetation was kept to a minimum and kept within the road or utility right-of-way.	☐	☐	☐	☐
Machinery was operated on land above the ordinary high water mark. Disturbance to the banks of the watercourse was kept to a minimum.	☐	☐	☐	☐
Fording to bring construction equipment to the opposite side was a one-time event (over and back) and only occurred because an existing crossing was not available or practical to use. Fording occurred under low flow conditions.	☐	☐	☐	☐
Where minor rutting was likely to occur, stream bank and bed protection methods (e.g., swamp mats, pads) were used and did not constrict flows or block fish passage.	☐	☐	☐	☐
There was no grading of the stream banks for the approaches.	☐	☐	☐	☐

Section D

Conformity With Measures To Protect Fish And Fish Habitat (continued)				
Measures to Monitor During Construction (only to be completed if you are on-site during construction)	**Compliance with Conditions**	**Not in Compliance**	**Unknown**	***N/A**
<u>Site Stabilization Mitigation (cont'd)</u>				
Damage to steep and highly erodible stream banks and beds by equipment fording was avoided through use of a temporary crossing structure or other method.	☐	☐	☐	☐
All waste materials removed from site were adequately stabilized to prevent escape into the watercourse.	☐	☐	☐	☐
<u>Deleterious Substances Mitigation</u>				
Machinery arrived on-site clean and free of fluid leaks.	☐	☐	☐	☐
Fuel and machinery materials were stored away from the water to prevent the escape of deleterious substances into the water. Machinery was serviced, washed, and re-fuelled away from the water.	☐	☐	☐	☐
Contractor had an emergency spill kit on-site.	☐	☐	☐	☐
Effective measures (e.g., dugout/settling basin, silt fences) were taken at the drilling exit site to prevent the escape of drilling mud and other deleterious materials into the watercourse. These measures were maintained in good repair during the course of construction.	☐	☐	☐	☐
Excess drilling mud, cuttings, and other waste materials were disposed of at a disposal facility away from the water to prevent it from entering the watercourse.	☐	☐	☐	☐
<u>Emergency Frac-out Response and Contingency Planning</u>				
Material and equipment needed to contain and clean up drilling mud releases were kept on site and readily accessible in the event of a frac-out.	☐	☐	☐	☐
Frac-out response plan was implemented and included measures to stop work, contain the drilling mud to prevent further migration into the watercourse, notify all applicable authorities including DFO, prioritize clean up activities relative to risk of potential harm, and dispose of the drilling mud in a manner that prevents re-entry into the watercourse.	☐	☐	☐	☐
Clean-up activities were undertaken in a manner that minimized further damage to the banks and watercourse.	☐	☐	☐	☐
The contingency crossing plan was implemented and included measures to either re-drill at a more appropriate location or to isolate the watercourse to complete the crossing at the current location (in this case refer to the *Isolated or Dry Open-cut Stream Crossings* Operational Statement).	☐	☐	☐	☐

Section D

Conformity With Measures To Protect Fish And Fish Habitat (continued)

Species at Risk (SAR) Considerations and Conditions:

Provide any additional details/ observations/ comments including the rationale for checking off 'Yes'. Please include any other issues relating to impacts on fish and fish habitat: Note: please use unique identifier number for photos

Is there a compliance issue with the *Species at Risk Act*? □ Yes □ No

Did the crossing occur on potential aquatic SAR Critical Habitat? **Yes No or Unknown** (Please Circle)

Other notes on Species at Risk areas including evidence of species presence, anything unique about the area, or issues/situations encountered not covered by this monitoring form.

Section E

Effectiveness Of Operational Statement

Did work carried out under this Operational Statements result in any negative impacts to fish and fish habitat?

☐ Yes ☐ No

If yes, why did the negative impact occur (check off all appropriate boxes)?

- ☐ Conditions were not followed and the project was outside of the scope of the Operational Statement
- ☐ Conditions were not adequate to protect fish habitat (Provide details below of what measures need to be added and why)
- ☐ Measures were not followed
- ☐ Measures were not adequate (Provide details below of what measures need to be added and why)
- ☐ Habitat Sensitivity (Provide details below)
- ☐ Other (e.g., extreme weather conditions)
- ☐ Unknown

Describe these impacts, how they may have been averted, and provide recommendations for improvement.

APPENDIX 4 (CONT'D): HIGH PRESSURE DIRECTIONAL DRILLING MONITORING FORM

For Fisheries and Oceans Canada Office Use only:

Monitoring Site Visit Completed by: _____

Others who attended site visit: _____

DFO Habitat File # (if applicable): _____ **Office:** _____

Proponent Notification Form (NF) Received □ **Yes** □ **No** **Date NF Received:** _____

Photos Taken: □ **Yes** □ **No** **Note:** Digital photos can be saved on the PATH Picture *screen*

Photo ID Number(s) and storage location _____

GPS Coordinates for site location (UTM) _____

Recommendations/Evaluation of Effectiveness of Operational Statement based on site visit observations:

_____

_____

_____

1. Were the Conditions in the OS met? ☐ **Yes** ☐ **No** ☐ **Partial** ☐ **Unknown**

(If not, was habitat impacted negatively (describe in notes on PATH screen)

2. Were the mitigation measures provided conformed with?
☐ **Yes** ☐ **No** ☐ **Partial** ☐ **Unknown**

(If not, was habitat impacted negatively (describe in notes on PATH screen)

3. Were the mitigation measures effective in preventing negative impacts to fish habitat?
☐ **Yes** ☐ **No** ☐ **Partial** ☐ **Unknown**

4. Are there remedial measures or additional mitigation measures required?
☐ **Yes** ☐ **No** ☐ **Unknown**

5. If required were remedial measures or mitigation measures implemented and/or conformed with?
☐ **Yes** ☐ **No** ☐ **Partial** ☐ **Unknown**

Common Questions:

1. Is there a compliance issue with the *Fisheries Act*? □ **Yes** □ **No**

2. If there is a compliance issue with the Fisheries Act, will there be further compliance action required? □ **Yes** □ **No**

3. Is Habitat Monitoring now complete on this action? □ **Yes** □ **No**

APPENDIX 5: SURVEY METHODS

Methodology:

Water Quality Parameters:

Note location in water column where samples were taken. For the purposes of this project most parameters can be measured at the water surface but if there are any changes record them in the comments portion of the spreadsheet.

Note the equipment type and most recent calibration date (if required). All manufacturers' instructions should be followed.

Water Temperature- Hanna Instruments Model HI93703
Conductivity- HI 93703

Turbidity- Equipment type- Hanna Instruments Model HI98311

Outside of cuvette should be cleaned before every measurement and inside should be double rinsed with distilled water prior to each test to ensure sediment from previous test removed. Do not allow the sample container to contact the bottom substrate to prevent contamination of the sample. The bottle should be held upright with the lid secured until the sample container is at the proper depth.

When sampling in fast, shallow water, make sure you take your sample from the surface. In these conditions, small particles of sand are often bouncing along the bottom. They may have nothing to do with the source of the sediment, but will give erratic test results. If possible avoid fast, shallow sampling sites. Take your sample a little upstream or downstream where water is deeper. Take water samples upstream of where you are standing to avoid contamination. If possible take samples without entering the wetted perimeter of the watercourse.

Habitat Parameters:

Transect locations-

1) At the center of the right of way:
2) 60 meters upstream of right of way: and
3) 60 meters downstream of right of way.

At each transect location measure the following:

Depth- Measured at the deepest location within the transect (thalweg). Use levelling rod or equivalent.

Wetted width- width of river/creek at the time of survey (see Figure 2)

APPENDIX 5 (CONT'D): SURVEY METHODS

Rooted width (Bankfull width) - See Figure 2 for description.

Range Finder- Bushnell Yardage Pro Sport Model 20-0015 or measuring tape for shorter distances (<10 meters)

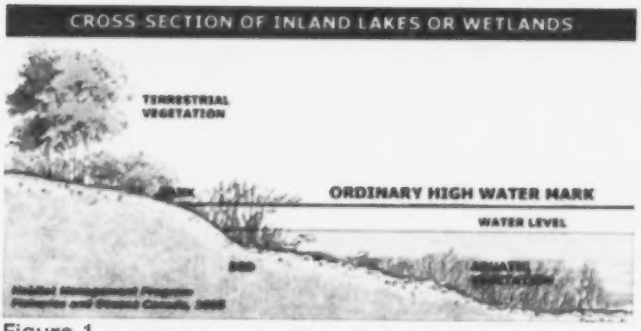

Figure 1

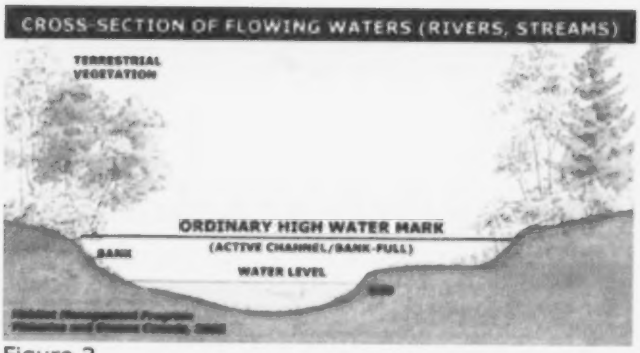

Figure 2

Small River or Stream Habitat Classification and Rating System
(Adapted from R.L.& L. Environmental Services Ltd. 1994 and Hawkins et al. 1993)

Channel Unit Type Class Map
Symbol Description

Falls FA- Highest water velocity; involves water falling over a vertical drop; Impassable to fish

Cascade CA- Extremely high gradient and velocity; extremely turbulent with entire water surface broken; may have short vertical sections, but overall is passable to fish; armoured substrate; may be assoc. with chute (RA/CH)

Chute CH- Area of channel constriction, usually due to bedrock intrusions; associated with channel deepening and increased velocity

APPENDIX 5 (CONT'D): SURVEY METHODS

Rapids RA- Extremely high velocity; deeper than riffle; substrate extremely coarse (large cobble/boulder); instream cover in pocket eddies and associated with substrate

Riffle RF- High velocity/gradient relative to run habitat; surface broken due to submerged or exposed bed material; shallow relative to other channel units; coarse

Substrate; usually limited instream or overhead cover for juvenile or adult fish (generally ≤0.5m deep)

Run (glide) R- Moderate to high velocity; surface largely unbroken; usually deeper than RF; substrate size dependent on hydraulics Depth/Velocity. Run habitat can be differentiated into one of 4 types: deep/slow, deep/fast shallow/slow, or shallow/fast.
R1- Highest quality/deepest run habitat; generally deep/slow type; coarse substrate; high instream cover from substrate and/or depth (generally >1.0 m deep)
R2- Moderate quality/depth; high-mod instream cover except at low flow; generally deep/fast or moderately deep/slow type (generally 0.75- 1.0m deep)
R3- Lowest quality/depth; generally shallow/slow or shallow/fast type; low instream cover in all but high flows (generally 0.5-0.75m deep)

Flat FL- Area characterized by low velocity and near-uniform flow; differentiated from pool habitat by high channel uniformity; more depositional than R3 habitat

Pool P- Discrete portion of channel featuring increased depth and reduced velocity relative to riffle/run habitats; formed by channel scour
P1- Highest quality pool habitat based on size and depth; high instream cover due to instream features and depth; suitable holding water for adults and for overwintering (generally >1.5m deep)
P2- Moderate quality; shallower than P1 with high-mod instream cover except during low flow conditions, not suitable for overwintering
P3- Low quality pool habitat; shallow and/or small; low instream cover at all but high flow events

Impoundment IP- Includes pools which are formed behind dams; tend to accumulate sediment /organic debris more than scour pools; may have cover associated with damming structure; identify as Class 1, 2 or 3 as for scour pools. Dam Three types of impoundments are based on dam type; debris, beaver and landslide

Backwater BW- Discrete, localized area of variable size exhibiting reverse flow direction; generally produced by bank irregularities; velocities variable but generally lower than main flow; substrate similar to adjacent channel with higher percentage of fines

Snye SN- Discrete section of non-flowing water connected to a flowing channel only at its downstream end; generally formed in a side-channel or behind a peninsula

Boulder Garden BG- Significant occurrence of large boulders providing significant instream cover; always in association with an overall channel unit such as a riffle (RF/BG) or run (e.g., R1/BG)

ADDITIONAL HABITAT MAPPING SYMBOLS
Symbol Description

Ledge LE- Area of bedrock intrusion into the channel; often associated with chute or plunge pool habitat, may have a vertical drop affecting fish passage
Overhead Cover OHC- Area of extensive or high quality overhead cover
Instream Cover ISC- Area of high quality instream cover (velocity shelter) for all life stages
Undercut Bank UCB- Area of extensive/high quality undercut bank providing overhead cover
Unstable Bank USB- Area of unstable bank with potential to collapse instream, affecting instream habitat or producing sedimentation
Overhanging Vegetation OHV- Area of high quality overhanging vegetation providing overhead cover and stream shade
Inundated Vegetation INV- Area of inundated vegetation; either submergent macrophytes or flooded terrestrial vegetation
Debris Pile DP- Debris pile (e.g., log jam) which influences instream habitat; include effect on cover
Root Wad RW- Fallen terrestrial vegetation large enough to provide cover for fish
Beaver Dam BD - Include effect on fish passage

Large River Habitat Classification System (R.L. & L. Environmental Services Ltd. 1994)

MAJOR HABITAT TYPES
Symbol Description

Unobstructed Channel U- Single main channel, no permanent islands, side bars occasionally present, limited development of exposed mid-channel bars at low flow
Singular Island S- Two channels around single, permanent island, side and mid-channel bars often present at low flow
Multiple Island M- More than two channels and permanent islands, generally extensive side and mid-channel bars at low flow

BANK HABITAT TYPES

Armoured/Stable
A1 Largely stable and at repose; cobble/small boulder/gravel predominant; uniform shoreline configuration; bank velocities low-moderate; instream/overhead cover limited to substrate and turbidity

A2 Cobble/large boulder predominant; irregular shoreline due to cobble/boulder outcrops producing BW habitats; bank velocity low (BW)/moderate; instream/overhead cover from depth, substrate and turbidity
A3 Similar to A2 with more boulder/bedrock; very irregular shoreline; bank velocities moderate-high with low velocity BW/eddy pools providing instream cover; overhead cover from depth/turbidity

A4 Artificial riprap substrates consisting of angular boulder-sized fill; often associated with high velocity areas; shoreline usually regular; instream cover from substrate; overhead cover from depth/turbulence
Canyon
C1 Banks formed by valley walls; cobble/boulder bedrock; stable at bank-water interface; typically deep/high velocity water offshore; abundant velocity cover from substrate/bank irregularities
C2 Steep, stable bedrock banks; regular shoreline; moderate-deep/moderate-fast water offshore; occasional velocity cover from bedrock fractures
C3 Banks formed by valley walls, primarily fines with some gravel/cobble at base; moderately eroded at bank-water interface; mod-high velocities; no instream cover

Depositional
D1 Low relief, gently sloping bank; shallow/slow offshore; primarily fines; instream cover absent or consisting of shallow depressions or embedded cobble/boulder; generally associated with bars
D2 Similar to D1 with gravel/cobble substrate; some areas of higher velocities producing riffles; instream/overhead cover provided by substrate/turbulence; often associated with bars/shoals
D3 Similar to D2 with coarser substrates (cobble/boulder); boulders often imbedded; moderate-high velocities offshore; instream cover abundant from substrate; overhead cover from turbulence

Erosional
E1 High, steep eroded banks with terraced profile; unstable; fines; moderate-high offshore velocity; deep immediately offshore; instream/overhead cover from submerged bank materials/vegetation/depth
E2 Similar to E1 without the large amount of instream vegetative debris; offshore depths shallower
E3 High, steep eroding banks; loose till deposits (gravel/cobble/sand); moderate-high velocities and depths; instream cover limited to substrate roughness; overhead cover provided by turbidity
E4 Steep, eroding/slumping highwall bank; primarily fines; moderate-high depths/velocities; instream cover limited to occasional BW formed by bank irregularities; overhead cover from depth/turbidity
E5 Low, steep banks, often terraced; fines; low velocity; shallow-moderate; no instream cover; overhead cover from turbidity

E6 Low slumping/eroding bank; substrate either cobble/gravel or silt with cobble/gravel patches; moderate depths; moderate-high velocities; instream cover from abundant debris/boulder; overhead cover from depth/turbidity/overhanging vegetation

SPECIAL HABITAT FEATURES
Type Symbol Description

Pool P- Discrete portion of channel featuring increased depth and reduced velocity relative to riffle/run habitats; formed by channel scour

Tributary Confluence TC- Sub-classified according to tributary flow and wetted width at mouth at the time of survey
TC Confluence area of tributary entering mainstem
TC1 Intermittent flow, ephemeral stream
TC2 Flowing, width < 5m
TC3 Flowing, width 5 - 15m
TC4 Flowing, width 16 - 30m
TC5 Flowing, width 31 - 60m
TC6 Flowing, width > 60m

Shoal SH- Shallow (< 1m deep), submerged areas in mid-channel or associated with depositional areas around islands/side bars
SHC Submerged area of coarse substrates
SHF Submerged area of fine substrates

Backwater BW
Discrete, localized area exhibiting reverse flow direction and, generally, lower velocity than main current; substrate similar to adjacent channel with more fines
Rapid RA Area with turbulent flow, broken surface (standing waves, chutes etc.), high velocity (>1 m/s), armoured substrate (large boulder/bedrock) with low fines

Snye SN- Discrete section of non-flowing water connected to a flowing channel only at its downstream end, generally formed in a side channel or behind a peninsula (bar)

Slough SL- Non-flowing water body isolated from flowing waters except during flood events;

Oxbows OX-

Log Jam LJ- Accumulation of woody debris; generally located on island tips, heads of side channels, stream meanders; provide excellent instream cover

The habitat types and specific features that make up the habitat upstream and downstream and at a crossing should be specifically identified. These are needed to evaluate the expected effects that the crossing will have on the habitat. Habitat characteristics to be measured include:

• Water quality: pH, conductivity (_S/cm), dissolved oxygen (mg/L) and turbidity. It must be recognized that these water quality parameters may vary with stream discharge and a single measurement will not provide information about this variation.
• Percent composition of streambed particle sizes (Table 4-3). This can be determined either as a visual estimation or through pebble counts (Kondolf 1997). Embeddedness of substrate particles and the presence of muck or detritus should be also noted.
• Existing barriers to fish movement such as beaver dams, falls, debris accumulation, perched culverts, intermittent or very low stream flow.
• Available instream cover for fish expressed as a percentage of all available habitat. The percent composition of different cover habitats (large organic debris, boulders, instream vegetation, turbidity, deep pools and surface turbulence) should be recorded.
• Available overhead cover for fish expressed as a percentage of all available habitat. The percent composition of different cover habitats (large organic debris, undercut banks and overhanging trees, shrubs or grasses) should be recorded.
• Stream or river banks: height, slope, percent coverage by riparian vegetation, type of riparian vegetation, percent of bank that is undercut, stability (evidence of slumping or erosion), presence of riprap, crib walls or other erosion control measures.
• Depth and velocity measurements of representative habitat units (e.g., pool, run and riffle). These parameters may vary with season and should be tied into the time of year.

Substrate Criteria (Overton et al. 1997)
CLASS NAME Size Range (mm)

Fines < 2
Small Gravel 2 – 16
Large Gravel 17 – 64
Cobble 65 – 256
Boulder > 256

For habitat features such as the stream bank, streambed composition, instream and overhanging cover, habitat characterizations at the crossing site should be determined separately from areas upstream and downstream of the crossing. This will allow for proper design of mitigation and compensation measures required as a result of the alteration or removal of habitat during bridge or culvert installation.

4.2.4 Watercourse Form and Flow Characteristics

Descriptions of watercourse form and flow patterns are needed to provide an understanding of the morphological processes that control the channel. An understanding of the nature of the channel and the process by which it was formed is

required to properly assess changes in the channel and accompanying channel habitats that may result from the crossing. Once these are determined, effective mitigation and compensation measures can be developed.

Following is a summary of stream morphology information that could be noted for each watercourse:

• Surrounding land use (e.g., agricultural, forestry, oil and gas development) and description of surrounding terrain (e.g., rolling hills);
• Stream pattern, sinuosity, meander wavelength, stream confinement, channel form, percentage of channel made up of side channels, streambed gradient (m/m), occurrence of natural drop-offs;
• Occurrence of gullying, slumping or erosion on valley or approach slopes;
• Mean wetted width, bankfull width and depth, and channel capacity width;
• Discharge (m3/s), turbulence, stage (dry, pooled, low, moderate, high, flood); and
• Flow type (ephemeral, intermittent or permanent).

Other
Right of Way Width- taken at intersection of river and right of way

Photographic Documentation:

Use Transect locations-

1) At the center of the right of way:
2) 60 meters upstream of right of way looking across the watercourse and one looking downstream toward the ROW: and
3) 60 meters downstream of right of way one picture looking across the watercourse and one looking U/S toward the ROW.

Photographs also should be taken of anything found onsite that is out of the ordinary (e.g., fish kill, evidence of frac-out, etc).

Please put reference item in the photograph for site interpretation/orientation.

APPENDIX 5 (CONT'D): SURVEY METHODS

Process leading up to Monitoring sites

1. PATH search for all ops files/data that involved a trenchless crossing
2. Collected files/data into an excel file via the Zone and UTM, UTM, Legal Descriptions and No location available
3. Reviewed each one to verify if in the SAR habitat regions of interest for SARA project 2010 (Alberta only)
4. Pulled files in SAR area and reviewed opts notification
5. Called proponents to verify project completion, date of completion, method, and any incidences associated with the project at time of construction (fracs, fording, erosion, other lines in area affected), or any other information proponent could offer.
6. Organized sites in reference to location to visit. Set tentative monitoring schedule with staff.
7. Site monitoring
8. Enter monitoring information into excel spreadsheet for future analysis
9. Download pictures into files labeled using PATH file number, river/creek name and date of monitoring.
10. 1 -2 page summaries prepared for each site

Methodology SARA 2010 Project

Large Rivers (Bow, South Saskatchewan, North Saskatchewan) Wetted and rooted widths taken from the wetted or rooted width from one side and using a range finder, kneeling down to get the most accurate readings. Readings were taken 3 times.

Small rivers and creeks all parameters measured physically using a measuring tape. Classification system used from R.L. & L 1994 and Hawkins et al. 1993.

Order of assessment

1. water chemistry and coordinates at ROW near shoreline, if not at ROW, location will be indicated on spreadsheet notes.
2. ROW/up/ Downstream - Riparian, Cover, and Substrate parameters, Pictures (4 at ROW up & down stream, LB and RB, 2 each up and down stream of LB and RB, more if site is unique or damages) Approximate width of each section being assessed is 6 meters. Up and down stream locations were assessed at approximately 60 meters, but varied due to accessibility and deviations will be noted on sheets
3. Sara Habitat 2010 Monitoring Forms completed after assessment or in the event of an active site, filled out at time of activity with the questions asked to the site supervisor, engineer or other informed parties available
4. Final walk around of site for any unusual activity or other land uses and final comments

References

Hawkins, C.P., Kershner, J.L., Bisson, P.A., Bryant, M.D., Decker, L.M., Gregory, S.V., McCulloch, D.A., Overton, C.K., Reeves, G.H., Steedman, R.J., and Young, M.K. 1993. A hierarchical approach to classifying stream habitat features. Fisheries, Vol. 18, No. 6:3–12.

Overton, C.K., Wollrab, S.P., Roberts, B.C., and Radko, M.A. 1997. R1/R4 (Northern/Intermountain Regions) fish and fish habitat standard inventory procedures handbook. General Technical Report INT-6TR-346. United States Department of Agriculture, Forest Service, Intermountain Research Station, Ogden, Utah. 73 p.

R.L. and L. Environmental Services Ltd. 1994. A general fish and riverine habitat inventory, Athabasca River, April to May 1992. NRBS Project Report No. 32, Edmonton Alberta. 74 p. + appendices.

APPENDIX 6: SUMMARIES OF SELECTED SITES ASSESSED SUMMER 2010

Estimated Work Competition Date	Watercourse	Turbidity (FTU)	Air Temp ° C	Water Temp ° C	Active (Y/N)	Method & Distance (m) from Bell hole @ ROW
2008	North Saskatchewan		10		N	HDD
June 1-8 2009	Bow River-Cochrane	7.7	19	12.6	N	HDD
June 2009*	Big Hill Creek	17.65	19	14.9	N	HDD
July 6-July 9 2010	Red Deer River (no spill kit)	21.28(standing), 31.1 (flowing)	24	22.1	Y	HDD - 59.4m
16-Jun-10	Tongue Creek	7.04	22	15.6	N	HDD - 22.5m
Fall 2009	Tongue Creek	7.8	22	16.6	N	HDD
Mar-09	Three Point Creek	41.46 (H2O not clear)	21.1	14.9	N	HDD - 30.63
Winter 2009	Ware Creek	18.25 (recent heavy rains, not clear)	20	16.1	N	HDD - 17.3
Winter 2009	Ware Creek	13.49	20	15.9	N	HDD
Spring 2007	Jumping Pound Creek	1.09	28	22.2	N	HDD - 45.7m
Mar-09	Bow River-Calgary	2	22	18.1	N	HDD - 56.6
09-Nov-09	Big Hill Creek	22.17	16	14.3	N	Bore - 22.80
Mar-09	Bow River - Siksika Reserve	10.31	26	20.9	N	Bore - 27.4
16-Jun-10	Unnamed Creek				N	
Mid-year 2009	Galwey Creek	3.88	27	16.9	N	Bore
Oct-09	Bow River - Taber	3.09	27	24	N	HDD - 201.1
Oct-09	Oldman River - Taber	7.8	22	22.2	N	HDD ~900 M from Entry to Exit
Spring 2010	Spring Creek - Okotoks	4.08	20	13.5	N	HDD - 90.5
17-Sep-08	Unknown	49.05	22	17.3	N	Bore >61m
Mar-10	North Saskatchewan	8.73	17.5	17.1	N	HDD
31-Oct-08	Unknown	4.34	24	19.1	N	Bore ~18m
Fall 2008	Unknown		18		N	Bore
12-Aug-10	Unknown	10.23	18	17.1	N	HDD >90 M
13-Feb-06	Unknown	NA	23	NA	N	HDD ~30 M or 52M
2009	Todd Creek	1.9	29	14.7	N	Bore - 28M
2009	Chaffen Creek	4.99	30	18.3	N	HDD
2007	Riley Creek	NA	28	NA	N	Bore
Mar-08	South Saskatchewan River	28.44	17	16.4	N	HDD ~80m
Sep-10	Fish Creek (exposed Pipe; no spill kit)	2.29	2.29	14.8	Y	HDD ~35m

Legend	Non Compliance	Not SAR habitat	Frac out	Exposed Pipe	Active Site – Compliance Issue